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5th Congress of the International Academy of Legal Medicine and of Social Medicine in Vienna

Under the auspices of this International Academy its fifth Conference will be held in Vienna from 22-27 May 1961. The President of the Congress is Prof. L. Breitenecker, Director of the Institute of Legal Medicine at the University of Vienna.

The programme covers a very comprehensive selection of topics which should, in addition, attract the interest of legal practitioners and international police authorities.

The details of the scientific programme are as follows:

PROGRAMME

Monday, 22 May (Whit Monday): Arrival.
Afternoon:
3.00 *p.m.*—6.00 *p.m.* Working Sessions for members of the Academy (Lecture Hall of the Institute of Legal Medicine, Vienna IX, Sensengasse 2).
Evening: Informal meeting of congress participants in the *Wiener Rathauskeller*, where dinner may be obtained.

Tuesday, 23 May:
Morning: Opening Session (Plenary Session).

SCIENTIFIC PROGRAMME

Principal Themes:
I. The Organization of Legal Medicine in Different Countries (Plenary Session).
II. Violent and Natural Death (Legal Pathology).
III. Toxicology.
IV. Rape, Indecent Offences, Abortion, Infanticide.
V. Legal Proceedings in Descendancy Cases.
VI. Medical Errors and their Legal Aspects; Liability.
VII. Criminal Investigation Techniques and Laboratory Methods.
VIII. Forensic Psychiatry and Criminology.
IX. Insurance, Occupational and Traffic Medicine.

Afternoon: The Organization of Legal Medicine in Different Countries (Plenary Session I).

Wednesday, 24 May:
Morning: Injuries and Death from Implements (II).
Abortion (IV).
The Medical Error and its Legal Aspects (VI).*
Forensic Psychiatry (VIII).

Wednesday, 24 May:
Afternoon: Forensic Toxicology (III).
Blood Groups and Serology (V).
Criminal Investigation Techniques (VII).
Insurance Medicine (IX).

Thursday, 25 May:
Morning: Injuries and Death from Fire-arms and Explosives (II).
Infanticide (IV).
Occurrences within Medical Practice, Tissue Transplantations and their Legal Aspects (VI).
Criminology (VIII).
Afternoon: Free for excursions to institutes, hospitals, medical museums, and police and legal institutions.

Friday, 26 May:
Morning: Violent Death from Asphyxia (II).
Rape and Indecent Offences (IV).
Blood Transfusion (VI).
Execution of the Sentence (VIII).
Afternoon: Poisoning through Drugs (III).
Human Genetics in Forensic Medicine (V).
New Instrumental Methods (VII).
Traffic Accidents, their Elucidation and Reconstruction (IX).

Saturday, 27 May:
Morning: Sudden Death from Natural Causes (II).
Injuries and Death by Change of Air Pressure, Starvation, Cold, Heat, Radiation and Electrocution (II).
Industrial Poisoning (III).
Disputed Determination of Sex; Generative Disability; Duration of Pregnancy (IV).
Liability (VI).
Questioned Documents (VII).
Forensic Psychology (VIII).
Occupational Medicine (IX).
Afternoon:
2.00 p.m.—3.00 p.m. Working session for members of the Academy.
3.00 p.m. Closing Session (Plenary Session).

The fee for members of Congress is $25 and that for persons accompanying members is $12. The official Congress languages are English, French and German. General information regarding the organization of the Congress can be obtained by writing to:

The Secretariat of the 5th Congress of the International Academy of Legal Medicine and of Social Medicine, Sensengasse 2, Vienna IX, Austria.

Medico-Legal Aspects of the Management of Erythroblastosis Fetalis*

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The discovery of the Rh factor by Landsteiner and Wiener[1] made possible the solution of two medical mysteries, viz. the pathogenesis of intragroup hemolytic transfusion reactions,[2] and of erythroblastosis fetalis (or hemolytic disease of the newborn).[3] It also led to the discovery and development of new sensitive methods of testing for Rh and other antibodies.[4] As a result, it is now possible, by typing the bloods of the expectant mother, her husband, and all their previous children and, by testing the expectant mother's serum for Rh–Hr antibodies during the pregnancy, to anticipate, in the great majority of cases, the occurrence of Rh hemolytic disease in the newborn baby before birth.

Following the discovery of the pathogenesis of erythroblastosis fetalis, an effective method of treating affected infants by exchange transfusion was devised,[5] so that nowadays, if such babies are not stillborn and are viable at birth, in the great majority of cases they can be saved by adequate treatment. Hemolytic anemia as the principal manifestation of erythroblastosis fetalis is relatively uncommon, and such affected infants readily respond to simple transfusion therapy. However, before the discovery of the Rh factor and the development of the modern precise serological tests, some babies in whom anemia developed insidiously remained unnoticed until the baby was 1–2 weeks old, by which time the anemia was so extreme that death occurred before treatment could be instituted. With modern diagnostic facilities, such cases should no longer be overlooked, so that the outcome nowadays is almost invariably favorable. A more common and more dangerous manifestation of erythroblastosis fetalis is jaundice, with or without anemia, which can lead to kernicterus and death or, in babies who survive, to mental and physical retardation. For this the only effective treatment known is exchange transfusion.

While the great majority of cases of erythroblastosis fetalis result from sensitization to the blood factor **Rh_0**, Rh–Hr hemolytic disease can also occur when the mother is Rh positive, due to sensitization to blood factors such as **hr′**, **rh″**, **rh′**, **rh^w** and still other factors of the Rh–Hr blood group

*Read before the Clinical Session of the American Medical Association, Washington, D.C., 28 November, 1960.

system.[6] The principle of treatment of such babies is the same as in Rh_0 hemolytic disease, except that it has not yet proved practicable to diagnose all such cases antenatally. Another important cause of hemolytic disease of the newborn is A–B–O incompatibility.[7] In almost all cases of A–B–O hemolytic disease the mother is group O and the baby group A or group B. Unfortunately, reliable tests are not available whereby the occurrence of A–B–O hemolytic disease in the baby can be anticipated antenatally with any degree of certainty.

An important recent development is the demonstration that the probability of occurrence of kernicterus is correlated with the degree of hyperbilirubinemia during the first few days of life.[8] Thus, by close observation of all newborn babies for the early onset of jaundice, one can recognize not only those cases of Rh hemolytic disease which require treatment by exchange transfusion, but also cases of erythroblastosis fetalis due to A–B–O and other incompatibilities. In a small percentage of cases of neonatal hyperbilirubinemia no blood group incompatibility can be demonstrated to account for the jaundice. Some of these cases can be traced to other causes such as birth trauma and infection and, where no cause can be found, the diagnosis of so-called physiological jaundice of the newborn is generally made. This, as a rule, is a benign condition and, if left untreated, spontaneous recovery is the rule. In a small percentage of the cases, however, especially in premature infants, jaundice may become extreme and such babies are apt to develop 'hyperbilirubinemic encephalopathy', and later may exhibit evidence of physical and mental retardation. Some workers have therefore advocated the treatment of unusually severe cases of physiological icterus by exchange transfusion, but a difference of opinion exists as to whether treatment in such cases is really beneficial; in addition, exchange transfusion itself is not entirely free from danger.

Many workers consider that whenever there is an increase during the first day of life in the level of indirect bilirubin in the blood serum of 1 mg. per 100 c.c. or more per hour, or whenever the blood bilirubin concentration is at or exceeds the 20 mg. per 100 c.c. level during the first 3 days of life, in cases of Rh or A–B–O hemolytic disease, or even in so-called 'physiologic icterus', exchange transfusion therapy is indicated. While the blood bilirubin level is a useful guide for treatment, to set an arbitrary figure such as 20 mg. per 100 c.c. is misleading and even dangerous, since it takes the control of the case away from the physician and places it in the hands of a laboratory technician, who may have little or no interest in, or understanding of the nature of the problem involved. For example, when the same blood sample is submitted to more than one laboratory for bilirubin determinations, not infrequently significantly different values are reported. Thus, a laboratory error could cause exchange transfusions to be carried out when they are not needed, while more seriously affected babies might

be left untreated. Therefore the laboratory findings alone should not be the only criterion used for treatment.

For this reason, in addition to, or instead of bilirubin determinations, the present author prefers to carry out icterus index determinations. This is a simple test which can be carried out rapidly by any physician who has available the necessary permanent dichromate color standards, a bottle of acetone and a centrifuge; and which restores the control of the case to the hands of the physician, where it belongs. During the neonatal period, there is a close correlation between the serum icterus index and the concentration of indirect bilirubin in the serum, the ratio generally being between 7 : 1 and 5 : 1, so that, e.g. an icterus index of 120 units would usually correspond to a total bilirubin concentration of approximately 20 mg. per 100 c.c. In our experience, kernicterus only occasionally occurs when the icterus index is below 180 units, corresponding to a bilirubin concentration of approximately 30 mg. per 100 c.c. or more, so that the use of the 20 mg. per 100 c.c. as a guide allows ample margin for error. However, since the procedure itself has a certain danger, the physician should not feel compelled to carry out an exchange transfusion every time that the bilirubin concentration reaches the 'magical' figure of 20 mg. per 100 c.c. When making his decision, the physician should be guided by his past experience and other aspects of the case in addition to the blood bilirubin concentration. If he believes that the jaundice has reached or is close to its peak, then treatment may be withheld, but if the likelihood appears to be that the bilirubin will continue to rise at a rapid rate, it may be safer to carry out an exchange transfusion. In cases where no blood group incompatibility has been shown to be present, viz. in so-called physiological icterus, the present author prefers to withhold treatment unless it seems virtually certain that the bilirubin concentration will reach or exceed the 30 mg. per 100 c.c. level if treatment is withheld.

It is evident that the optimal management of erythroblastosis depends on teamwork between the obstetrician, the pediatrician and the immunohematologist, during the pregnancy, and especially during the neonatal period. Improper management can lead to disaster and may have medico-legal repercussions. This may perhaps best be demonstrated by citing a number of case reports.

Case Reports

Case 1*

The patient, a female infant, appeared strong at birth and showed no physical evidence of any abnormality. The baby was the result of the mother's fifth pregnancy. The 4 previous deliveries had all yielded normal babies with no neonatal jaundice or anemia;

*The facts presented here were all obtained by study of photostatic copies of the original hospital records, and signed statements of the litigants.

they were all alive and well. There was no record on the hospital chart of any tests for Rh antibodies having been done on the mother during the pregnancy.

During the fifth pregnancy the mother of the patient had reported to the obstetrician, who drew blood for a Wassermann test. At that time, he asserts, he told the mother to report to the hospital for an Rh test, but, according to his statement, she laughed and said, 'My blood is all right. I have four healthy children. I don't need any Rh test.' According to the obstetrician, he responded, 'I want you to have it taken anyhow.' However, when she was admitted to the hospital in labor, according to the records, her blood group and Rh type had still not been determined.

According to the mother, when the baby was 12 hours old, she noticed that the whites of the baby's eyes were jaundiced. However, neither the mother nor anybody else appears to have done anything about this. By the time the infant was 3 days old she was obviously jaundiced, and the obstetrician then ordered a test for the Rh factor on the mother, and an erythroblast count on the infant. The blood typing showed the mother to be Rh negative, and the baby's hemoglobin concentration proved to be 15 g. % with an erythroblast count of 8. The obstetrician then called a pediatrician into consultation, but the latter did not report until the following morning, when he saw the baby together with the obstetrician. At that time, the fourth day of life, according to the obstetrician, the jaundice was only slight, about the same as the previous day, so that it could have been 'physiologic jaundice', and the baby's condition seemed good; there was no fever and the baby was feeding well. The infant was then left in the care of the pediatrician.

On the morning of the fourth day a complete blood count was done, which showed a hemoglobin concentration of 16 g. %; red blood cells, 5·35 million per c.mm.; white blood cells, 11,850 per c.mm., with 55 polymorphs, 41 lymphocytes, 4 monocytes and 2 erythroblasts per 100 white cells. According to the pediatrician, the baby at that time seemed well, except for mild jaundice, so he concluded that the baby probably had physiologic jaundice, and that nothing further had to be done. However, when he returned in the evening the nurse informed him that the baby had refused her feed and had a temperature of 102°F. On examination the baby proved to be drowsy, toxic and much more jaundiced, so a Coombs' (direct anti-globulin) test was ordered, which proved to be positive. The pediatrician then requested a consultant to see the baby. By the time the consultant arrived that evening, the baby was acutely ill, feverish and intensely jaundiced and, based on the information that the mother was Rh negative, and that the father, who had been tested that morning, was Rh positive, and that the direct anti-globulin test on the baby was positive, he concluded that the baby was erythroblastotic, though he also mentioned the possibility that the baby might have sepsis or meningitis. A blood culture was taken, which later showed no growth, and when the technician arrived a short time later and reported that the bilirubin concentration was 42 mg. per 100 c.c., the baby was ordered to be transferred to another hospital for treatment.

The baby was admitted to the second hospital with an admission diagnosis of severe erythroblastosis, with a possibility of septicemia and meningitis. Because of the possibility of sepsis, blood cultures, nose and throat cultures, umbilical and stool cultures were taken; also lumbar puncture was attempted, but without success. The baby's hemoglobin concentration proved to be 14 g. % on admission, and the bilirubin concentration 40·9 mg. per 100 c.c. while the direct anti-globulin (Coombs') test was reported to be 2+ to 3+ positive. An immediate exchange transfusion was then begun, which was carried out by the umbilical catheter method; but because of difficulty with the withdrawal of blood, the procedure took 5 hours, during which time 570 c.c. of blood were administered, while 500 c.c. of blood were withdrawn. There was no apparent change in the baby's condition. On the evening of the fifth day the bilirubin concentration was found to be 21·2 mg. per 100 c.c., and a second exchange transfusion, this time using 320 c.c. of blood, was carried out. Thereafter, the jaundice cleared progressively, so that by the 11th day the bilirubin concentration was only 1·9 mg. per 100 c.c.

While the patient was at the hospital, A–B–O grouping and Rh–Hr tests were carried out on the family. The Rh–Hr tests were reported in the terms of the C–D–E notations, and those findings (correctly expressed in terms of the Rh–Hr notations) as recommended by the Committee on Medicolegal Problems of the American Medical Association[9] are shown in Table 1:

Table 1

Blood of	*Age*	*A–B–O Group*	*Rh–Hr Type*
Father		O	Rh_1rh
Mother		O	rh
1st child	16	O	rh
2nd child	15	O	Rh_1rh
3rd child	11	O	Rh_1rh
4th child	2	O	Rh_1rh
5th child (patient)		O	Rh_1rh

According to these results, it is quite evident that the father is heterozygous for the Rh factor, since not only is his type Rh_1rh, but the first child in the family is type rh. It is amusing to note, however, that on the hospital chart had been inserted the note: 'The father's genotype is heterozygous or anti-D.' (*sic*).

It was early apparent that the patient had sustained severe brain damage. On admission to the second hospital the baby had been lethargic, had a poor cry, the Moro reflex was absent, and the gripping and sucking reflexes were poor. The blood culture showed gram-negative bacilli and gram-positive cocci in chains, and this was considered to confirm the diagnosis of neonatal sepsis, complicating erythroblastosis fetalis and kernicterus. The baby showed marked spasticity of the upper extremities, which was treated with Thorazine, under which the baby was kept throughout the hospital stay, until she was 7 weeks old. Because of the severe brain damage, the question of institutionalization was broached to the parents. In the out-patient department it was noticed that the baby probably had a quadriplegia, and the baby was therefore referred to the cerebral palsy clinic.

A lawsuit was started by the father, as guardian *ad litem* of the infant, as well as on his own behalf, against the obstetrician, pediatrician, consultant, and the hospital at which the baby was born. The present writer was consulted by the attorney for the plaintiff. Grouping tests were carried out on the patient and her parents with the following results:

Father: O MN Rh_1rh; mother: O MN rh; and the patient: O N Rh_1rh.

These results are the same as those reported at the hospital, where the exchange transfusion had been carried out, except that at the hospital the M–N tests had not been done, and the 4 older children, who had been tested there, were not tested by the present author. As far as could be determined, no tests for Rh antibodies had been done on the mother at either hospital. Tests carried out by the present author for Rh antibodies on the mother's serum gave the following results:

Agglutination method: negative; blocking test: positive, 1 unit; albumin-plasma conglutination method: positive, 30 units; anti-globulin method; positive, 48 units; and ficinated cells: positive, 108 units.

These results showed that the mother was strongly sensitized to the $\mathbf{Rh_0}$ factor, as was to be expected from the history.

Analysis of the findings in the case history leaves no doubt that this baby had severe erythroblastosis fetalis, and the marked hyperbilirubinemia (as

high as 42 mg. per 100 c.c.) gave rise to kernicterus which was largely, if not entirely, responsible for the baby's severe mental damage. That the baby may also have had a neonatal sepsis seems doubtful, since the fever occurred at the peak of the hyperbilirubinemia and this is a common sign of nuclear involvement of the brain. Besides, the blood cultures at the first hospital showed no growth, while the organisms isolated at the second hospital could easily have been due to contamination of the broth cultures, and the results had never been confirmed.

The obstetrician could be considered negligent for his failure to insist that the Rh tests be done antenatally, despite the mother's protests. In fact, part of the blood that had been drawn for the Wassermann test could easily have been sent to the laboratory for the Rh test. By 1956, when this case occurred, Rh typing and tests for Rh antibodies had become part of the routine management of all pregnant women.

The pediatrician who was called in on the third day at the first hospital could also be considered negligent, for not considering the possibility of erythroblastosis more seriously, and for not having taken more active steps in establishing the diagnosis. Perhaps, if the diagnosis had been made even at that late date, and an exchange transfusion carried out promptly, the outcome might have been different.

The hospital was not at fault, since the laboratory technician did all the tests requested, and the results reported by the laboratory technician all appear to have been correct. Neither was the consultant at fault, because as soon as he was called in to see the patient, he took active steps to establish the diagnosis, and as soon as this was made had the baby transferred to the second hospital for treatment. By that time, however, the serum bilirubin concentration had reached 42·8 mg. per 100 c.c., so that the damage had probably already been done, and damage to the brain once it occurs cannot be repaired.

This case illustrates the relative uselessness of blood counts for making a diagnosis of erythroblastosis fetalis, and as a guide for treatment. On the other hand, the value of Rh–Hr typing, Rh antibody titrations, the direct anti-globulin test on the baby's cells, and blood bilirubin determinations are well exemplified. An amusing sidelight was the use of the C–D–E notations at the second hospital, because the assertion that these notations are to be preferred when reporting the Rh–Hr types because they are 'easier to understand' certainly is contradicted by the resident's note that 'the father's genotype is heterozygous or anti-D' which shows his complete lack of understanding. It is of interest also to note that difficulty was encountered with the exchange transfusion, which took 5 hours for exchanging a single unit of blood. Presumably the procedure was carried out by the umbilical catheter method, and the difficulty may perhaps be attributed to the fact that the transfusion was carried out on the fourth day of life. On the other hand, the radial-artery/saphenous vein technique, which is preferred and

used exclusively by the present author, can be carried out without difficulty, independently of the baby's age; in addition, it is safer because it is not a blind procedure, and uses expendable peripheral blood vessels. A minor limitation of the procedure is the fact that there are only 2 radial arteries but this is not a serious disadvantage because only rarely does any indication arise for more than 2 exchange transfusions.

After the author's interpretation of the findings was submitted, he recommended that, if possible, the case be settled out of court. He was subsequently notified by the attorney for the plantiff that the insurance company for the obstetrician and pediatrician had settled the claim out of court for $47,000. It might be pointed out that this is perhaps a relatively low settlement for a case of this nature. The attorney for the plaintiff remarked that he had not permitted the case to go to trial, because of the long delay this would entail, and he felt that if the baby died in the interval, which seemed quite possible, the verdict would be smaller, since generally smaller verdicts are rendered when the patient dies, than when the patient survives but is left with permanent damage.

Case 2

The patient in this case is a woman, who while still unmarried, at the age of 28 years, underwent a nasal operation to correct a deviated septum. Because of excessive bleeding after the operation, she was given a transfusion of 500 c.c. of group A, Rh-positive blood, and before she left the hospital was given an identification card on which were marked her name and her blood group as A, Rh positive.

A few months later she married and within a short time became pregnant. When retyping of her blood then proved that she was Rh negative and not Rh positive, it became evident that an error had been made. During her pregnancy Rh tests were carried out on her husband which showed him to be type Rh_1rh, while tests on the patient's serum for Rh antibodies showed her to be sensitized to the **Rh_0** factor. The advisability of terminating the pregnancy prematurely by Cesarean section was debated, but luckily this was not done, because the baby proved to be Rh negative and was normal.

A suit was then initiated by the patient and her husband against the hospital where the plastic operation was done, the pathologist there, and the surgeon. The patient asserted that as a result of the transfusion of Rh-positive blood, she had developed a neurosis and hysteria, and that because of her fear of further pregnancies, sexual relations between her and her husband had become infrequent and unsatisfactory. For this, she demanded $150,000 in damages, while her husband wanted $50,000 for loss of her services.

At the request of the insurance company, the claimants were examined by the author, and grouping tests showed the following:

Patient, A_2 M k rh; husband, O N k Rh_1rh; and daughter, O MN k rh.

These results confirmed the previous report that the patient was Rh negative, the husband Rh positive, and the daughter Rh negative. Therefore, the husband had to be heterozygous for the **Rh_0** factor, and in any future pregnancy there would be a 50–50 chance that the baby would be either Rh positive or Rh negative.

Tests for Rh antibodies on the patient's serum gave the following results:

Agglutination test, negative; albumin-plasma conglutination method, positive, 4 units; anti-globulin method, positive, 24 units; ficinated cells, positive, 32 units.

These results showed a mild to moderate degree of Rh sensitization. Thus there seemed no or hardly any doubt that an error had been made at the hospital where the nasal operation had been performed.

A transfusion of Rh-positive blood to an Rh-negative recipient, except in dire emergency or in other unusual circumstances, is *prima facie* evidence of negligence. The fact that the patient had no untoward reaction to the transfusion can be explained on the grounds that she was not sensitized at the time she received the transfusion. Thus the Rh antibodies which she now had, had evidently been induced by this transfusion, since her daughter was Rh negative, hence the pregnancy could not have sensitized her. Whether an Rh-negative person is sensitized or not has no effect on his health, but if the individual is a woman of child-bearing age, such Rh sensitivity could give rise to erythroblastosis fetalis in any subsequent Rh-positive child.

These facts were brought out at the trial. Since the error had been committed by a technician employed by the hospital, the case against the 2 physicians was dismissed. However, a judgment for the plaintiff was rendered against the hospital in the amount of $20,000.

Case 3

The patient was a baby girl, and the result of her mother's second pregnancy. The mother's only previous pregnancy had yielded a normal female infant, who was alive and well, but concerning whom no other information was available. The patient was born after a spontaneous delivery 2 weeks before term, and within 72 hours the baby was noticed to be jaundiced. Since the mother was known to be Rh positive it was elected to treat the baby expectantly. On the following day, however, the jaundice deepened, and the serum bilirubin concentration proved to be 23 mg. per 100 c.c. Since the mother was group O and the baby group A, a diagnosis of A–B–O hemolytic disease was made, and an exchange transfusion with one pint of blood was carried out. For 2–3 days the jaundice remained unchanged. Then it began to fade, and the baby was discharged from the hospital on the tenth day of life. Unfortunately, the subsequent development of the baby was not satisfactory, since there was both physical and mental retardation. This raised the question whether the baby had sustained brain damage as the result of the hyperbilirubinemia during the neonatal period.

A lawsuit was instituted by the parents of the baby against the physicians who had treated the baby. It was charged that the physicians had been negligent in withholding exchange transfusion therapy until the serum bilirubin concentration had exceeded the 20 mg. per 100 c.c. mark, and that as a result of this presumed negligence the baby had sustained brain damage. The present author was then consulted by the plaintiff's attorney for his opinion concerning the merits of the action.

When the baby was seen at the office, she was obviously retarded, and grouping tests carried out on her and her parents showed the following:

Father, A_1 M K Rh_1rh; mother, O MN k Rh_1Rh_1; patient, A_1 MN K Rh_1rh.

These results show that the patient had 3 blood factors, **A**, **K** and **hr′**, which were lacking from the blood of her mother. Tests on the mother's serum showed that she was not sensitized to the **hr′** or **K** factors, so that, by exclusion, the findings appeared to support the diagnosis of A–B–O hemolytic disease. Unfortunately, the blood of the first child was not available for testing, but the fact that a subsequently born child, who had no neonatal jaundice was said to be group O, supported this diagnosis. Moreover, titrations of the isoantibodies in the mother's serum showed her to be rather strongly sensitized as follows:

Agglutination method: A_1 cells, 40 units; A_2 cells, 15 units; B cells, 15 units; acacia conglutination method: A_1 cells, 960 units; A_2 cells, 260 units; B cells, 800 units.

Finally, the fact that the baby belonged to subgroup A_1 was another point supporting the diagnosis.

Saliva tests showed that the mother was a secretor, while the father and baby were both nonsecretors. There are reasons to believe that nonsecretor babies are not as well protected against the effects of the maternal isoantibodies as are secretor babies, and this might account for the unfortunate outcome in the present case. Another possibility to be considered, of course, is that the baby's physical and mental retardation was merely coincidental, and not related to the neonatal jaundice which she had had. At any rate, Case 3 is quite different from Case 1. In Case 1, transfusion was withheld because of ignorance of the diagnosis through negligence and delay in the handling of the case, while in Case 3, treatment was withheld deliberately and with full knowledge of the nature of the jaundice, so that if any error had really been made, it was an error in judgment for which no physician may be held legally responsible.

In this connection, a recently reported lawsuit[10] for malpractice is relevant. In what appeared to be a mild case of hepatitis, after 10 days of treatment, a boy was permitted by his physician to go home from the school infirmary. He then had a relapse and, despite treatment at a hospital, his condition deteriorated; 3 years later he died of cirrhosis of the liver. The father then sued the doctor for negligence in allowing the boy out of bed too soon, and for having departed from the orthodox treatment of the disease. Mr. Justice Streatfeild held that the doctor was not guilty of negligence, since his problem had been not merely to treat hepatitis, but a *particular* patient, so that he had to bear the whole picture in mind. Every physician is entitled to use his common sense based on his own experience, and

'It would be a sorry day for the medical profession if it were said that no doctor or surgeon ought to depart one tittle from what he saw written in a textbook. Any disease which started by being mild could in the end turn out to be serious, but because a case did end seriously a doctor could not be said to be negligent because he did not form the opinion it would be serious.'

Comment

In Rh hemolytic disease, the role of hyperbilirubinemia in the pathogenesis of kernicterus appears to be established. Hsia *et al.*[11] found no kernicterus when the bilirubin level remained below 5 mg. per 100 c.c.; the incidence was 3% with bilirubin values between 6 and 15 mg. per 100 c.c.; 18% with serum bilirubin between 16 and 30 mg. per 100 c.c.; and 50% when the serum bilirubin exceeded 30 mg. per 100 c.c. Similar observations have been reported by Mollison,[11] who found no kernicterus with serum bilirubin values below 18 mg. per 100 c.c., but an incidence of 75% with serum bilirubin above 30 mg. per 100 c.c. Since exchange transfusion has proved so efficacious in preventing kernicterus in Rh hemolytic disease, negligence and unnecessary delay in diagnosing and treating Rh hemolytic disease with resultant damage to the baby may be a proper cause of action for a malpractice action, as in Case 1 reported in this paper.

On the other hand, the proper management of A–B–O hemolytic disease is not as clear-cut as that of Rh hemolytic disease. Firstly, there are no tests by which A–B–O hemolytic disease can reliably be anticipated antenatally, and the first-born baby of an incompatible blood group is often affected. Secondly, A–B–O hemolytic disease is generally milder, spontaneous complete recovery is the rule, and fatalities are rare. However, the disturbingly high incidence of neurological sequelae[7] indicates that treatment is desirable, at least in the more serious cases. As an indication for exchange transfusion therapy, serum bilirubin determinations are invaluable, because (as in Rh hemolytic disease) it has been found that the likelihood of kernicterus appears to be correlated with the serum bilirubin level. However, there is dissatisfaction with the results of exchange transfusion, which in A–B–O hemolytic disease is not infrequently followed by aggravation of the jaundice, while comparable cases left untreated may show spontaneous improvement. That is the reason why the tendency has been to treat A–B–O hemolytic disease expectantly, and to withhold exchange transfusion therapy even in cases with bilirubin levels exceeding 20 mg. per 100 c.c.

In Rh hemolytic disease it has been found that transfused Rh-positive cells are generally eliminated rapidly from the erythroblastotic infant's circulation, while Rh-negative cells have 'normal' survival. This is not difficult to understand since, as a rule, free Rh antibodies are generally demonstrable in the baby's plasma in addition to the antibodies coating his red cells. Therefore, the consensus is that in Rh hemolytic disease, Rh-negative blood should be used when carrying out exchange transfusion. After exchange transfusion the jaundice may nevertheless increase, so that not infrequently it is necessary to do a second exchange transfusion.

Similarly, in group A babies with A–B–O hemolytic disease, Mollison[11] found that transfused group A cells have shortened survival while group O cells have normal survival. In a recent case of A–B–O hemolytic disease in a group B baby, treated by the author, exchange transfusion with group B blood led within 48 hours to some increased hemolysis and deepening jaundice, even though no free anti-**B** isoantibodies could be demonstrated in the baby's plasma. Apparently, the mother's isoantibodies are neutralized or bound in the baby's tissues and/or body fluids from which they can be gradually released by dissociation of the antigen-antibody complex. Therefore, the consensus has been to use group O blood for exchange-transfusion of babies with A–B–O hemolytic disease. Not infrequently, however, such transfusions appear to aggravate instead of ameliorating the process. This may in some cases be due to the incompatible isoantibodies in the group O donor's plasma, introduced by the exchange transfusion. The use of so-called 'low-titer' or 'safe' universal donors, and/or the addition of blood group substances as suggested by Witebsky, does not provide an entirely satisfactory solution because of the large volume of blood transfused. Recently we have tried exchange transfusion with washed group O red cells resuspended in group AB plasma, and preliminary observations indicate that such exchange transfusions may yield more satisfactory results.

The management of babies with Rh hemolytic disease born to parents who are Jehovah's Witnesses, a sect whose precepts forbid the ingestion of blood or blood transfusion in any form, poses a special problem. If exchange transfusion is withheld the baby may die or, if he survives he may be left with permanent brain damage, all of which might have been prevented by prompt treatment. In at least 2 such cases, therefore, physicians have appealed to the law, and in emergency hearings the erythroblastotic babies were made wards of the court, and a temporary guardian appointed who permitted the operation to be carried out. In both cases complete recovery resulted, the guardianship was then terminated, and the infants returned to their parents. This same procedure should be followed in the future in all similar cases of this nature.

Summary

At the present stage of knowledge, routine antenatal Rh typing, followed by testing for sensitization of all Rh-negative expectant mothers with Rh-positive husbands, is part of the management of all pregnancies. Negligence, through failure to carry out such tests, and avoidable delay in diagnosing Rh hemolytic disease in time to treat affected babies who require exchange transfusion, with resultant death or permanent damage to the baby, may lead to unpleasant and expensive lawsuits for medical liability.

The management of A–B–O hemolytic disease and 'physiologic' hyperbilirubinemia is less clear-cut, because of the difficulties in diagnosis and

and the not infrequent unsatisfactory response to therapy. While the use of a serum bilirubin concentration of 20 mg. per 100 c.c. as an indication for exchange transfusion is helpful as a guide, this should not be absolute, because each case must be individualized. Exchange transfusion itself carries a certain danger, and it is just as important to avoid overtreatment. In any event, an unfortunate outcome is not of itself necessarily proof of negligence, so long as the physician has used his best judgment in the management of the case.

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The Estimation of Stature in British and East African Males

Based on Tibial and Ulnar Bone Lengths

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Over 60 years ago Karl Pearson wrote that 'the extension of the stature regression formula from one local race . . . to other races . . . must be made with very great caution.' Since then the findings of other workers in this field have confirmed the wisdom of this remark. For example, Stevenson (1929) was unable to obtain accurate stature estimations of north Chinese cadaveric material by the use of the Pearsonian formulae, and von Eickstedt (1931) found similar deficiencies in the use of these formulae whilst investigating the skeletal proportions of a negrito population in the Philippine Islands.

The same problem was encountered when it was required, for forensic purposes, to estimate the stature of individuals from various East African autochthonous populations from the length of the long bones. Trial estimations were made by applying the formulae of Manouvrier (1892) and of Pearson (1899) derived from Rollet's measurements of southern French cadavers; of the formulae constructed by Dupertuis and Hadden (1951) from American Negro and White cadaveric material; of the formulae of Trotter and Gleser (1952) derived from American Negro and White subjects of measured antemortem stature and postmortem dried limb bone lengths; and of the formulae calculated from stature and percutaneous bone measurements in living German students by Breitinger (1937). All gave stature estimations which were too great when tested against a sample East African population by methods similar to those used by Breitinger.

These findings confirmed the critical study of Keen (1953, 1955) who demonstrated the fallacy of the methods of pooling and averaging both of bone lengths and populations groups. That such methods have been advocated may be attributed to the paucity of data available from different human populations (Boyd and Trevor, 1953). Wells (1959) ends his discussion on stature estimation in African populations with the plea that 'further studies on the relation of limb-bone lengths to stature in European and African populations are clearly essential to ascertain whether estimates by the American formulae are reasonably accurate within the limits of unavoidable error, or whether special formulae must be derived.'

A living population of East African and British males was available for study, on which stature and percutaneous lengths of selected long bones were used to obtain data from which to construct regression equations. Comparison of long bone lengths determined in the living with data obtained from direct osteometry of the appropriate bones of prepared skeletal material of similar sex, age and ethnic type will also be presented.

Description of Material

The living subjects consisted of 429 males composed of 7 groups of varying ethnic origin and provenance. The mean ages of the groups ranged from 19.5 to 22.1 years. Groups 1 to 6 were indigenous African, Group 7 was British. More detailed information is provided in Table 1 in which the term 'students' refers to undergraduates at Makerere College, Uganda, the term 'tribesman' refers to young men in a prison population in Karamoja District, Uganda, and the term 'National Servicemen' refers to soldiers of the British Army at that time stationed in Kenya.

Table 1: Information Concerning the 7 Groups used for Purposes of Statistical Analysis for Differences in the Means of Stature and Percutaneous Tibial and Ulnar Lengths

Group	*Number*	*Age (Years)*		*Occupation*	*Ethnic or Linguistic Classification*	*Provenance*
		Mean	*Range*			
1	7	20·3	19-21	students	Nilohamite	Teso, Karamoja
2	30	"mature young men"		tribesmen	Nilohamite	Karamoja
3	7	22·1	20-26	students	Nilote	Lango, Acholi, Luo, Alur
4	74	21·5	18-25	students	Bantu (Lacustrine)	Ganda, Nyoro, Nkole Toro, Soga (Uganda)
5	72	21·0	18-29	students	Bantu (Eastern)	Kikuyu, Meru, Embu, Kamba (Kenya)
6	39	21·3	19-25	students	Bantu	Sukuma, Nyamwezi, Chagga (Tanganyika)
7	200	19·74	18-34	soldiers	British	English-Welsh Border

In this study it is convenient to use the term 'Nilote', 'Nilohamite' and 'Bantu' as labels for particular African tribal groups characterized by distinctive linguistic, cultural and physical features. In the strict sense these terms are used to classify the East African populations on a linguistic basis. It is considered wise for the present to adhere to this nomenclature since the physical examination and classification of these populations is still incomplete.

The dried long bones chosen for comparison with the living were from documented skeletal material which has been collected over the past ten years and is preserved in the Department of Anatomy, Makerere College. The sex, tribal origin, and approximate age of each skeleton is known.

The left tibia and ulna from 53 normal appearing male skeletons were selected. Of these, 6 were of Nilohamite, 11 of Nilote and 36 of Bantu (Lacustrine) ethnic origin (Table 4).

Measurement Technique

Measurement of the Living. In the living subjects the standing height (barefoot, feet together, with trunk braced, eyes forward and with the lateral palpebral commissure and tip of the auricle in the same horizontal plane) was measured with a stature-rod. The subject then sat with the left knee semi-flexed and the left foot partly inverted in order to relax the soft tissues and render bony landmarks prominent, whilst the left tibial length was measured with spreading calipers from the medial condyle (as it becomes palpable and diverges anteriorly from the articulating femoral condyle) to the tip of the medial malleolus (sphyrion). The left forearm was flexed and semi-pronated with the hand in the neutral position, whilst the ulnar length was measured from the tip of the olecranon process to the distal margin of the head, palpable on the dorsum of the wrist. Measurements were made with pointed tip caliper arms mounted on a detached section of a standard three-segment stature rod.

Dried Bone Measurement. Each left tibia was placed on the osteometric board and the maximum length from the tip of the malleolus to the tibial spine was recorded. The maximum length of each left ulna was similarly measured from the styloid process to the proximal end of the olecranon.

Statistical Treatment of Data

The data obtained from the living subjects were analysed in the following manner:

1. For each of the 7 groups the means and standard deviations of stature, tibial length, and ulnar length were determined.

2. Differences among mean statures of the 7 groups were studied by the analysis of variance, and comparisons among all pairs of group means were analysed by the method of Tukey (1949).

3. The means of tibial lengths and of ulnar lengths of the 7 groups were compared by the analysis of variance.

4. Regression analysis was employed to determine whether or not stature increased with age in each of the 7 groups.

5. The linear regression equations relating stature and each of the two long bone lengths were determined for each of the 7 groups and tests of parallelism and position of the separate regression lines were made.

Results

Comparison of Group Means of Stature, Tibial Length and Ulnar Length

The mean, range and standard deviation of stature, tibial length, and ulnar length of each group are presented in Table 2.

Table 2: Means, and Standard Deviations for Stature, Tibial Length and Ulnar Length, and Ranges for Stature in Groups 1 to 7

Group	*Number*	*Stature (cm.)*			*Tibial Length (cm.)*		*Ulnar Length (cm.)*	
		Mean	*Range*	*S.D.*	*Mean*	*S.D.*	*Mean*	*S.D.*
1	7	167·43	160·5-177·0	5·72	41·67	2·00	29·07	1·61
2	30	177·71	171·2-180·5	5·21	43·32	2·44	30·63	1·32
3	7	172·23	162·0-180·0	8·95	42·29	4·17	30·39	2·06
4	74	164·98	150·0-191·5	6·99	39·96	2·20	28·79	1·52
5	72	164·25	152·0-178·5	5·95	39·84	1·93	28·18	1·20
6	39	163·57	154·5-182·9	7·12	39·21	2·62	28·22	1·81
7	200	172·06	157·1-187·2	5·97	38·34	2·11	27·13	1·33

The variances of the statures in the 7 groups were found by Bartlett's chi-square test to be homogeneous, with a probability, P, greater than 0.10. The means of the statures, however, were shown by the analysis of variance to be significantly different ($P < 0.001$), indicating that they were unlikely to have been drawn in random sampling from a common population. The analysis of the differences among mean statures of the 7 groups and a comparison of the group means in all the pairs gave the following results:

Group 1 (Nilohamite, N = 7) did not differ significantly from any of the other group means.

Group 2 (Nilohamite, N = 20) had the highest mean stature and differed significantly from each of the other group means. For each pair P was less than 0.01, except for the comparison of Group 2 and Group 3 in which case P was less than 0.05.

Group 3 (Nilote, N = 7) differed significantly from Groups 2, 4, 5 and 6, but not from Groups 1 or 7.

Groups 4, 5 and 6 (East African Bantu, N = 185) did not differ significantly from one another but each one, and the combination of all 3, differed significantly from Groups 2, 3 and 7.

Group 7 (British, N = 200) differed significantly from Groups 2, 4, 5 and 6, but not from Groups 1 and 3.

A similar analysis of the differences of the mean tibial lengths (at a level where $P < 0.001$) among the 7 groups gave the following results:

Groups 1 and 3 did not differ significantly from each other, but did differ from all the other groups in mean tibial length.

Group 2 was significantly longer in tibial length than any other group.

Group 4, 5 and 6 had mean tibial lengths which did not differ significantly from each other, but which were significantly shorter than Groups 1, 2 and 3, and longer than Group 7.

Group 7 had a short mean tibial length which was significantly different from the 6 African groups.

Analysis of the differences of mean ulnar lengths among the 7 groups showed a similar pattern to that found in the case of the tibial lengths, with the exception of Group 4 (Lacustrine Bantu) which had a mean ulnar length which was significantly longer than Groups 5 and 6 ($P < 0.01$).

In the consideration of these results it is well to point out forthwith that failure to prove a difference between group means does not imply proof either that the means were equal or that they are from a similar population. Failure to prove differences could well be due to the small size of some samples.

The Effect of Age on Stature, Tibial Length, and Ulnar Length

Among the African groups of known age (Groups 1, 3, 4, 5 and 6) no significant differences in the mean ages were found. The mean age of these five groups combined was 21.4 years with a range of 18 to 29 years. No increase of stature with age could be demonstrated in these combined groups. However in Group 5 (Eastern Bantu), after exclusion of the two individuals over 25 years old (mean age 20.7 years, $N = 70$) stature was found to increase significantly with age, with an increment of 1.56 cm./year ($P < 0.01$). In no other African group was this demonstrable.

The mean age of Group 7 (British) was 19.7 years with a range of 18 to 34 years. When this group was analysed for increase of stature with age the calculated increase of 0.24 cm./year did not differ significantly from zero. However after the exclusion of four individuals over 25 years of age (mean age 19.6 years, $N = 196$) there was then found to be a significant increase of stature with age, with an increment of 0.74 cm./year ($P < 0.05$).

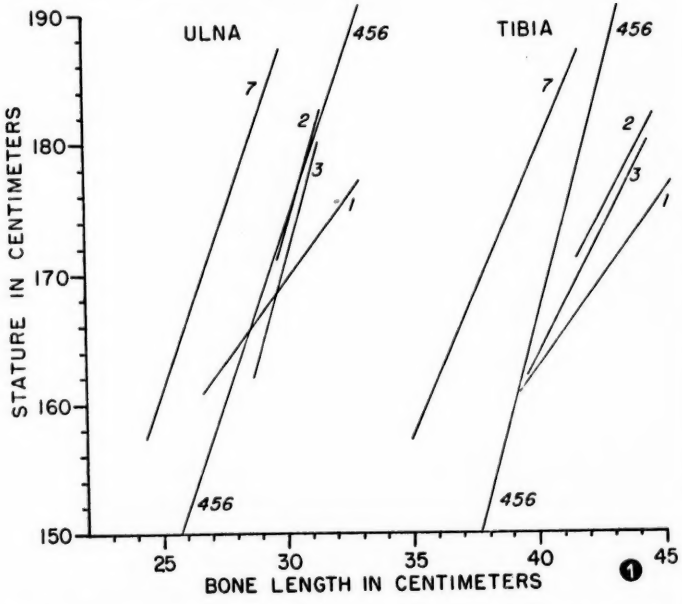
In neither the African groups nor the British group was there found to be a significant increase of tibial (or of ulnar) length with age, even when individuals over 25 years of age were excluded. It is therefore inferred that individuals from Groups 5 and 7 were continuing to grow in stature even though epiphysial fusion of the tibia had stopped growth in this bone.

Comparison of the Linear Regression Equation in the Seven Groups

In each of the 7 groups the best fitting straight line for the estimation of stature from the tibial and ulnar lengths was determined by the method of least squares. The slopes and positions of these lines are shown in Fig. 1. In all groups except 1 and 3 the slope of the lines for both tibia and ulna differed from zero ($P < 0.001$). In the small Groups 1 and 3 the slopes either did not differ significantly from zero or were significantly different only at the $P < 0.05$ level.

Groups 1, 2 and 3 were found, by the analysis of covariance (Snedecor, 1956), to have linear *slopes* that did not differ among themselves, or from the slopes of Groups 4, 5 and 6, or from the slope of Group 7.

However the *positions* of the best fitting lines in Groups 1, 2 and 3 were significantly different from each other. The positions of Groups 4, 5 and 6 were not significantly different from each other, but were significantly different from the position of Group 7 ($P < 0.001$), which was also different from the positions of Groups 1, 2 and 3.



The regression equations calculated from the stature, tibial length and ulnar length data are shown in Table 3. As the position of the best fitting lines in Groups 1, 2 and 3 differed significantly from each other they are represented by separate equations. The equations for Groups 1 and 3 are based on small samples. Because of this, and because the students composing these groups were drawn from widely different tribes inside the broad ethnic groups they represent, the regression equations should not be

Table 3: Regression Equations (Including Standard Error of Estimate) for Estimation of Stature from Tibial and Ulnar Lengths in Groups 1 to 7

Group	*Stature (cm.) from given Tibial Length (T) (cm.)*	*Stature (cm.) from given Ulnar Length (U) (cm.)*
1	$S = 2{\cdot}15T + 77{\cdot}74 \pm 3{\cdot}76$	$S = 1{\cdot}19U + 132{\cdot}81 \pm 5{\cdot}39$
2	$S = 2{\cdot}00T + 91{\cdot}19 \pm 1{\cdot}89$	$S = 3{\cdot}26U + 77{\cdot}94 \pm 2{\cdot}97$
3	$S = 1{\cdot}96T + 89{\cdot}26 \pm 3{\cdot}65$	$S = 3{\cdot}59U + 63{\cdot}17 \pm 5{\cdot}06$
4, 5, 6	$S = 2{\cdot}50T + 65{\cdot}00 \pm 3{\cdot}73$	$S = 3{\cdot}24U + 72{\cdot}31 \pm 4{\cdot}63$
7	$S = 2{\cdot}30T + 83{\cdot}78 \pm 3{\cdot}46$	$S = 3{\cdot}06U + 88{\cdot}94 \pm 4{\cdot}38$

regarded as final or definitive. By contrast the equation for Group 2 (also Nilohamite like Group 1) is based on a larger sample from a local geographical area within the Karamajong tribal area. Groups 4, 5 and 6 are represented by a common equation in Table 3 since it was determined by the analysis of covariance that neither in slope nor in position of the best fitting lines did these groups differ from each other.

The Effect of Age on the Linear Regression Equation

The standard error of estimate is the calculated measure of the error likely to be made in any particular stature estimation derived from a given bone length. It is possible that the value of the standard error of estimate could have been reduced by a small amount in the present work if age had been included as a factor in the calculation of the multiple regression equation. But since (with the exception of a part of Group 5 and Group 7) age was not correlated with stature it was not taken into account in the calculation of the equations shown in Table 3.

Comparison of Percutaneous Bone Lengths in the Living with Dried Skeletal Measurements

The means of the tibial lengths taken on the living subjects of Groups 1, 3 and 4 when compared with the means of tibial lengths of dried bones measured on the osteometric board showed no significant differences. It has already been shown that there is a significant difference between the tibial mean lengths of the three groups measured percutaneously and this is also true in the case of the dried bones.

In the comparison of the ulnar lengths, those of the dried bones were significantly longer than the percutaneous measurements in both the Nilote and the Lacustrine Bantu groups. The comparative data are summarized in Table 4.

Table 4: Comparison of Percutaneous Tibial Length and Ulnar Length Mean Values in Living Subjects with the Same Values Measured on Dried Bones on the Osteometric Board

		Number	*Mean Tibial Length (cm.)*	*Difference*	*Mean Ulnar Length (cm.)*	*Difference*
Group 1. (Nilohamite)	Percutaneous Length	7	41·67	Not significant	29·07	Not significant
	Dried Bone Length	6	42·15		29·07	
Group 3. (Nilote)	Percutaneous Length	7	42·29	Not significant	30·39	$P<0.05$
	Dried Bone Length	11	40·93		28·70	
Group 4. (Lacustrine Bantu)	Percutaneous Length	74	39·96	Not significant	28·79	$P<0.01$
	Dried Bone Length	36	39·82		27·79	

Discussion

Stature as an Ethnic Character. In a localized population of a given major ethnic group the mean stature is a valid characteristic of that particular group. For example among the Caucasians the mean stature of the present Group 7 (172.06 cm.) is not significantly different from the mean stature of 171.5 cm. of two million unselected British males recorded over a period of 100 years (Morant, 1950). These means differ from the mean of 170.1 cm. recorded by Breitinger for 2,400 German athletes and students. All these statures are shorter than the mean of 173.95 cm. which was recorded by Trotter and Gleser (1958) for United States white military personnel.

Among negroid peoples Trotter and Gleser's mean stature of 173.43 cm. for United States Negroes is not significantly different from the caucasoid mean stature reported in the same study. By contrast the East African Bantu speaking group of negroids represented in this study by Groups 4, 5 and 6 were short, with a mean stature of 164.40 cm. But among the East African groups there were tall people, best exemplified by the pastoral Karamajong tribesmen (Group 2) belonging to the Teso cluster of Nilohamites. These people have a greater stature than any Caucasian sample encountered, with a mean of 177.71 cm. The Karamajong are comparable in stature to the Watussi of Ruanda who have a mean stature of 176.52 cm. (Hiernaux, 1954), and the Sudanese such as the Dinka cluster and the Kotoke who, with a mean stature of 180.6 cm., are the tallest human population on record (Talbot, 1916).

The Effect of Body Proportion on the Stature Regression Equation

When the proportion of length of the distal limb segment to stature is considered a fundamental difference appears between the caucasoid and the negroid races. This is demonstrated in the scattergram shown in Fig. 2 in which stature is plotted against tibial length and against ulnar length for the entire sample of 429 males. There is seen to be a separation of caucasoid and negroid symbols and a further separation of the latter into Nilote-Nilohamite and combined Bantu symbols. Though such a difference in proportion is common knowledge, the lack of data hitherto has prevented its application to the problem of the estimation of stature from known long bone lengths in African negroids.

The method used in this study for measuring tibial length in the living is comparable to that used by Breitinger (1937), thus allowing a comparison between the two sets of data. When the mean tibial length of the British (Group 7) was substituted into Breitinger's equation, the estimated stature (171.90 cm.) did not differ significantly either from the measured (172.06 cm.) or the estimated mean stature (171.96 cm.), using the Group 7 equation

in Table 3. Because the slope of the best fitting line was steeper for Group 7 than for Breitinger's data, estimates at the extremes of the scale in a few trial substitutions gave poorer estimates than those around the mean, although they were still within the standard error of estimate. It may therefore be concluded that Breitinger's formula gives nearly as precise estimations for British males as the equation derived from their own measurements (Table 5).

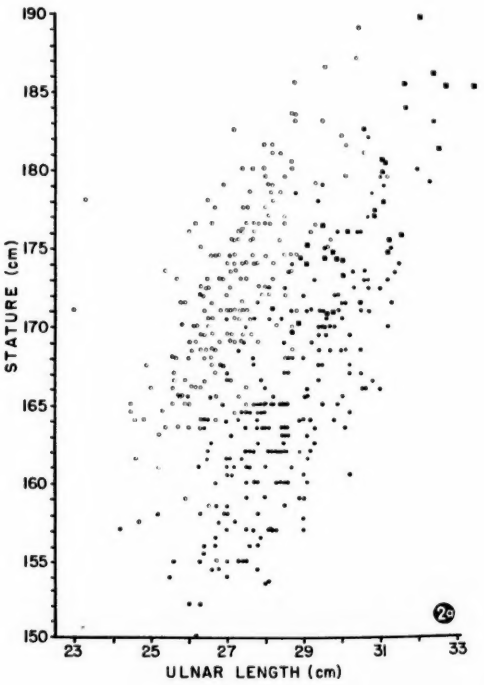
Table 5: The first 2 lines give the mean observed stature and tibial length measurements. The observed stature is to be compared with estimated stature obtained by substitution of the mean tibial length in the 6 given formulae (3 from the present work (Table 3), 3 from work dealing with other populations)

	Group 2 (*Nilohamite*)	*Groups* 4, 5, 6 *Combined E. African* (*Bantu*)	*Group* 7 (*British*)
Mean observed tibial length (cm)	43·32	39·76	38·34
Mean observed stature (cm.)	177·71	164·56	172·06
Mean stature (cm.) estimated from group equation given in Table 3	177·83	164·40	171·96
Mean stature (cm.) estimated from S = 2·19 T + 85·36 (U.S. Negro, Trotter & Gleser, 1958)	180·23	172·24	169·32
Mean stature (cm.) estimated from S = 2·392T + 81·68 ('General' or combined U.S. Negro and U.S. White, Dupertuis and Hadden, 1951)	185·30	176·79	173·39
Mean stature (cm.) estimated from S = 1·99T + 95·6 (German, percutaneous tibial length in living, Breitinger, 1937)	181·81	174·72	171·90

In contrast to this, when Breitinger's equation is applied to any of the African groups (e.g. Group 2 or the combined Groups 4, 5 and 6) the calculated stature is always greatly in excess of the actual observed mean stature (bottom line, Table 5). Similarly too large results are obtained by the use of the Pearsonian formula, and also from the application of the formulae derived from Caucasian material given by Dupertuis and Hadden (1951) and by Trotter and Gleser (1952, 1958).

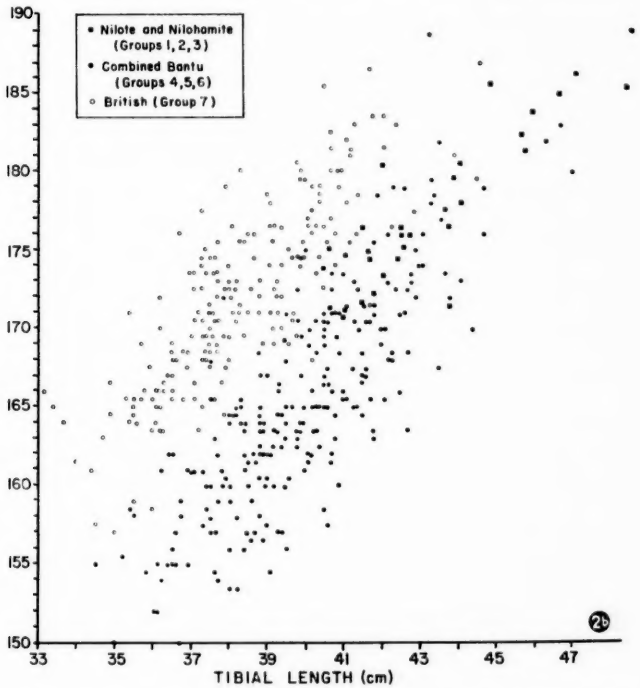
Of special importance are the tests to demonstrate whether or not equations derived from United States Negro material give accurate estimations of stature when they are used on East African material. In Table 5 the relevant United States Negro equation given by Trotter and Gleser (1958) is used for the present data belonging to Group 2 and the combined Groups 4, 5 and 6. In this Table the 'general' or combined United States Negro and United States White equation given for the tibia by Dupertuis and Hadden (1951) is also used, and the results of both equations may be com-

pared with the actual mean stature and the estimated mean stature obtained by the use of the equations derived from Group 2 and the combined Groups 4, 5 and 6. In every case the use of equations derived from United States Negro material gave estimates that were too large.



Trotter and Gleser (1958) made clear the need for specific formulae for the ethnic groups studied by them. In the present study statistical evidence has been presented that the African negroid Groups 1 to 6 should not be considered as from a homogeneous sample. This finding is of special significance in the light of the alleged lack of coincidence between physical characters and linguistic grouping which is said to be characteristic of many African, and especially East African tribes. In this study the East African Bantu speaking groups were found to be similar in mean stature, in mean absolute bone lengths and in the stature-long bone length proportions. The 14 representatives of the Nilotic and Nilohamitic linguistic group of tribes among the college students were from diverse geographic and tribal backgrounds and were variable in all three lengths measured. As the samples were both small and diverse it is not recommended that the formulae

derived from these Groups (1 and 3) should be utilized, neither should biological inferences be drawn from the failure to show statistically significant differences from Group 7. The case of Group 2 is different. The



individuals were drawn from a localized Karamajong tribal cluster and though still small in number this group had the highest mean stature and long bone lengths, differing significantly from each of the other group means. The calculated regression equation for this group is therefore recommended for use only in the case of the Karamajong or other related Nilohamitic peoples.

Influence of Age on Stature

Although increase of stature in the young is brought about by linear growth of each skeletal moiety contributing to the final stature, the total stature may be considered conveniently to be produced by growth in length of the trunk and growth in length of the inferior limbs. (It is of interest that the proportions of these two segments of the body differ widely in Caucasian and Negro peoples).

In the present investigation stature was found to increase with age in Group 5 and in Group 7 when individuals over the age of 25 years were omitted from the analysis. Both these groups were younger in mean age than the total sample. Tests were made to see if there was a corresponding increase in tibial length with age in these groups. This was not found, and therefore it must be assumed that growth in length of the tibia had ceased in these samples. Trotter and Gleser (1958) noted a similar phenomenon (not only in length of tibia but also in length of femur) in United States White subjects (but not in United States Negroes). The increase of stature with age without a corresponding increase of tibial and femoral lengths with age was attributed by them to a growth in length of the vertebral column after tibial and femoral growth in length was completed. It is known that the time of final closure of all the vertebral annular epiphysis which contribute to the length of the trunk is later than that of the long bone epiphyses. As with the limb bones there is a time order of epiphysial fusion of the various vertebral components with the last fusing as late as 25 years.

Comparison of Percutaneous Bone Lengths in the Living with Dried Skeletal Measurements

Breitinger (1937) discussed the extent to which various percutaneous skeletal measurements correspond to the actual physiological length of the dried skeleton. It is clear from Breitinger's discussion of radiological investigations of the arm and the thigh that the relation of fixed bone points for his percutaneous measurement to the physiological maximum length of the humerus and femur respectively, varied widely from case to case. In a similar comparison between percutaneous and radiological measurements of the tibia and radius respectively Breitinger found a close correspondence in results. In the present investigation too the tibial length measured on living subjects has been shown to correspond closely with the measurement made on the skeletal material from the appropriate tribal sources. A similar correspondence was not found between the two methods in the case of the ulnar lengths, probably because the accuracy of this percutaneous measurement was dependent on landmarks more difficult to identify and more variable than were the landmarks of the tibia.

Tibial length measurements give a better estimation of stature than ulnar length measurements not only because the measurement is technically more easy, but also because the tibial length is itself a part of stature. Similar considerations would apply to the case of the femur if this could in fact be measured percutaneously in the living with a similar degree of accuracy.

Summary

Stature, tibial length, and ulnar length were measured on 199 male East African College undergraduates, 30 Nilohamitic tribesmen, and 200 British soldiers.

These 429 individuals were placed into 7 groups according to ethnic origin and provenance, for purposes of statistical analysis.

The means and standard deviations for the 3 measurements were calculated and differences among group means were studied by the analysis of variance. The tallest group was that composed of the Nilohamitic tribesmen (mean stature 177.71 cm.), who also had the *longest* mean tibial and ulnar lengths. Nearly as tall were the British males with a mean stature of 172.06 cm., who had the *shortest* mean bone lengths. The East African Bantu tribes were short in stature with a mean of 164.4 cm. but their bone lengths were significantly *longer* than those of the British.

Measurements from dried skeletal material made in a comparable manner to the percutaneous measurements in the living subjects showed no statistical difference when the two sets of tibial data were compared. But in two of the groups the mean ulnar lengths were significantly longer in dried bones than in the percutaneous measurements.

In the Eastern Bantu and the British, regression analysis demonstrated that there was an increase of stature with age up to 25 years but no corresponding increase of tibial length with age.

Linear regression equations relating stature to tibial length and to ulnar length were calculated for each of the seven groups. No significant difference was found among the groups for parallelism of the best fitting lines. All regression lines of the Bantu groups were the same in position, but were different from those of the Nilotes, Nilohamites and the British, which were also different from each other. Both student groups of 7 Nilotes and 7 Nilohamites were too small to give reliable equations representing their respective populations.

Thus for the 7 groups initially defined, 5 groups were large enough to allow the regression equations calculated to be used for their appropriate populations. Of these, the combined East African Bantu (Groups 4, 5 and 6) may be represented by a single equation, but the Nilohamite Karamajong (Group 2) and the British (Group 7) each requires its own regression equation. When applied to the appropriate populations these equations gave stature estimations which were more precise than those obtained from published equations derived from material of different ethnic composition.

It is a pleasure to record my thanks to Makerere College Council for a research grant to defray the expenses of this investigation, and to the undergraduates who willingly assisted in the actual work.

My thanks are due to the Commanding Officer, Adjutant and Medical Officer of the 6th Battalion, King's Shropshire Light Infantry for their help and courtesy.

The statistical analyses are by Mrs. Barbara Bartels Hixon, Lecturer in Biostatistics, Washington University School of Medicine, whose advice was invaluable. She was assisted by Mrs. Jane Simon.

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The Status of Interrogation Drugs in the United States

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Employment of scopolamine hydrobromide to obtain confessions in criminal cases was an American innovation.[1] Scopolamine was later replaced by various barbiturate drugs, particularly sodium pentothal and sodium amytal, for the interrogation of persons suspected of crime and in psychoanalytical diagnosis and treatment. Today medical and judicial practitioners throughout the world are attempting to resolve the ethical, scientific and legal problems bearing on the relationship between narco-interrogation and jurisprudence. In this regard, details of present conditions in the United States, where the procedure had its birth, might be of interest.

It must be kept in mind that there are at least 51 separate systems of justice in the United States, including those of the states and the federal government. While the courts of these various polities draw upon one other and upon the general heritage of common law for their precedents, there is no binding force necessarily making the decisions of one court applicable to those of another.

Nonetheless, there is considerable similarity in the letter and the spirit of various American decisions on the use of interrogation drugs in criminal cases. There has been a particular proliferation of cases involving these drugs during very recent years as some of the peripheral areas come under adjudication. In addition, medical practice is constantly impinging upon court situations by its growing use of narcoanalytic techniques in diagnosis and treatment. In all, some 22 court decisions in the United States have dealt with situations in which so-called truth serum drugs were involved.

There is only one American case in which there was a use of an interrogation drug *without the subject's consent* with the aim of eliciting information about guilt. This case was something of a national *cause celebre*, involving a University student who had committed more than 500 burglaries, and had murdered four females, the last being a 6-year-old child.[2] In some respects, this case bears resemblance to the French case of Raymond Cens, which has received considerable attention in American medical and legal circles.[3]

The American suspect, William Heirens, was believed to be malingering when he refused to respond to police interrogation. An eminent Chicago psychiatrist was induced to administer sodium pentothal to Heirens while two prosecuting attorneys, the police commissioner and a stenographer hid

themselves behind a screen, listening to and transcribing the conversation between Heirens and the doctor while the suspect was under the influence of the drug. In the course of the pentothal interview, Heirens blamed the criminal acts on a fictitious *alter ego,* George Murman.

The appellate court was forthright in its condemnation of this police behavior:

> . . . the unauthorized use of sodium pentothal . . . was a flagrant violation of his rights. Such conduct on the part of law enforcement officials deserves the severest condemnation, especially in view of petitioner's age and emotional instability, and any conviction obtained as a result of such practice would violate constitutional rights or due process of law.[3a]

In the Heirens case, the court decided that the ultimate confession had not been elicited by the use of the drug, since it was not tendered until more than 4 weeks later. But the court's words indicate that confessions coming directly from the use of drugs or based on information so derived will not be tolerated in American courts.

The great majority of American cases do not involve situations in which the police attempt to employ truth serums to prove guilt, but rather cases in which the subject has asked the court to admit his statements of innocence made under the influence of a barbiturate drug. Accused persons have requested that they be given or allowed to use a truth serum test to prove alibis,[4] have asked that a psychiatrist be allowed to testify that they are incapable of committing the crime (usually a sex offense)[5], or have requested a second trial on the basis of information which they say was elicited by the use of interrogation drugs after the original conviction.[6]

The first American case involving an interrogation drug, *State* v. *Hudson* in 1926, spelled out the doctrine which has been almost invariably followed in cases where the accused asks the admission of information based on narco-interrogation. In this case, the judge noted:

> Testimony of this character—barring the sufficient fact that it cannot otherwise be classified than as a self-serving declaration—is, in the present state of human knowledge, unworthy of serious consideration . . . The trial court ruled correctly in excluding this clap-trap from consideration of the court.[7]

The only minor exception to this rule occurred in a highly controversial California case in 1954. Here, a psychiatrist offered to testify for the defense that the accused was not a sexual psychopath, and therefore could not possess the culpability required to be sentenced under the state's so-called 'sexual psychopath' statute. The court permitted the psychiatrist to testify, even though his conclusion was based in part on the results of a sodium penthothal interview. The court drew a sharp distinction between the specific material revealed during the interview, and the psychiatrist's general conclusion based on statements made by the suspect. The former, it stated, would not be heard in court; the latter constituted legitimate expert testimony.[8] The California decision has been sharply defended and

challenged in the American law reviews.[9] It is significant to note that no other American court appears inclined to follow its lead.

Narco-interrogation interviews have been used occasionally in cases in which sanity is directly in issue, and in these cases the position of the courts has been uncertain and wavering. In an early case, *People* v. *Esposito* in 1942, the New York court allowed the psychiatrist to testify on the outcome of metrazol and sodium amytal interviews of Esposito at Bellevue Hospital. The court ruled that by his plea of insanity Esposito had made himself 'subject to the use of methods set up objectively by the medical profession for the proper determination of such pleas.'[10]

Ten years later, however, the same state's courts refused to allow psychiatric testimony concerning an accused's mental status when such testimony was based on sodium amytal interviews.[11] Yet, most recently, the pendulum appears to have swung back to its original position as an Oklahoma court permitted evidence obtained from the employment of sodium pentothal in the examination of a defendant committed to a mental hospital for a sanity examination prior to trial on a charge of rape.[12]

In all these cases, however, it should be noted that there is a sharp line, though sometimes it is implied rather than stated, between information on the mental attributes of the accused, particularly as concerns his sanity, and information directly bearing on his guilt or innocence of the crime with which he is charged. No American court has yet allowed details of admissions or confessions which derive from narco-interrogation procedures; nor is it likely that any court will do so.

Two other cases in the United States relating to truth serums involve attempts by the prosecution to rehabilitate its witnesses by the use of supporting accusatory statements made while under the influence of sodium pentothal. In both instances, one of them a federal case, the courts have refused to permit this stratagem. The first case was tried in the courts of Alaska and involved an incest and statutory rape charge. After the young girl's honesty was challenged, the prosecution introduced a tape recording of an earlier interview made while the girl was under the influence of an interrogation drug, and during which she repeated her accusation. The appellate court declared that she could have lied just as readily under the influence of the drug as on the witness stand, and it would not permit the jury to hear the recording. This court objected strenuously also to the use of the term 'truth serum' by the prosecution during the trial.[13] The same conclusion was reached in a similar case in Florida in 1957.[14]

One of the most interesting American cases involving interrogation drugs took place in Illinois during 1957. A suspect was given an injection of scopolamine in order to alleviate withdrawal symptoms brought on by his forced abstinence from heroin to which he was addicted. In the course of this treatment, which is one of the usual medications in such situations,

the arrested youth confessed to a murder charge. The court subsequently allowed the confession, though much judicial controversy revolved about the question of whether the scopolamine was still effective 15 hours after its administration, when the confession was repeated. There was an apparent judicial belief that the effect of the drug had worn off, and that the accused retained his free will when he confessed. One justice dissented.[15]

In summary, it should be noted that cases involving the use of interrogation drugs are appearing with increasing frequency in American courts, indicating that there remain many unresolved problems in connexion with their ultimate legal status. Only a few items seem to have been settled unequivocally. The drugs may not normally be administerred without the accused's consent to this act, though there remains some question as to whether he waives this right when he pleads insanity.

There is no dispute that the accused may not use truth serum tests to prove his innocence, though again there are shaded areas involving questions of basic personality configurations and tendencies as these bear upon the criminal act. The courts regard efforts to introduce drug-derived material bearing directly on the offense as hearsay, self-serving and basically unreliable. American courts have not yet come to grips with the constitutional problem of self-incrimination in regard to interrogation drugs, though the applicability of this time-tested constitutional doctrine seems evident. While a coterie of academic commentators takes the position that these drugs should be barred absolutely from legal matters, the American courts themselves presently appear unwilling to take any definitive position. In February 1960, Bernard Botein, presiding justice of the Appellate Division of the New York Supreme Court, First Department, called the attention of lawyers to some of the future implications of interrogation drugs, remarking:

> Our traditional litigation ground rules are designed to elicit truth on the notion that justice will follow truth. But what if science will reproduce truth more reliably and effectively than does our present system? When that time arrives, and science establishes truth through more trustworthy means (such as hypnosis, lie detectors, and interrogation drugs) we shall not be able to defer our rendezvous with progress.[16]

Pending the arrival of the time anticipated by Judge Botein, however, the decisions of American courts on interrogation drugs are marked by tentative stands, and somewhat uncoordinated and occasionally contradictory philosophies. At the moment, the courts seem dedicated to meeting each novel situation as it arises, and judging it on its particular merits. One senses that the courts would like to see a clearcut ideological stand relative to the drugs and the techniques involved in their use by the American medical profession. It seems obvious, however, that such a stand is not likely to emerge in the near future.

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Individuality of Dry Blood

A Density Gradient Study*

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Fundamental differences other than blood groups, in the blood of different individuals, is indicated in various publications.[1-3] More extensive differences, of a quantitative nature, are found on a transient basis as a result of nutritional and environmental factors and exercise. Such temporary differences are of no value as a basis for absolute individualization of blood, but they may serve admirably for distinguishing between the bloods of 2 or more individuals when the bloods were shed at the same time, as often occurs during the commission of crime. If such blood samples belong to the same blood group, as often happens, this distinction can be of the greatest value in criminal, and sometimes civil, investigation.

As encountered in most investigative work, blood is in the form of dry spots, smears or pools. To be of great value, any technique for distinguishing between blood of different persons should be applicable to such dry material. This criterion is met, in part, by available blood grouping methods, zone electrophoresis[4] and certain antibody determinations. It is rarely met by the ordinary quantitative analytical procedures because of the uncertainty of sample size and other complications.

The measurement or comparison of density has been very effective in distinguishing between different similar samples of many dry materials.[5] It has also served as an effective clinical determination with liquid blood samples[6] which show significant variations useful for diagnostic purposes. Although the water content of blood is most important with liquid samples, it appeared possible that dissolved constituents might also vary enough to give useful differences in the density of dry blood samples. Perhaps variations in protein content would be a major factor in determining density variations of the solid and even more so, variations in fat content, generally transient in nature.

Reported here is a study of the variations in density between different samples of dry blood, many obtained from the same person at various

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times, others from different persons but drawn at the same time. The solid samples proved to be eminently suitable for density comparison by means of tube gradients. Variations in the gradient distribution were actually much more pronounced than had been anticipated. Reproducibility of duplicates was excellent, and gave evidence of very significant potential value in criminal investigation.

Experimental

Gradients. All gradients were established in Pyrex glass tubes 6 mm. OD and 9 inches long. Solutions of zinc chloride were added in 7 layers, each of which had a different density, as shown below. The heaviest layer (stock solution No. 1) was made to density 1.507 by dissolving 695 g. of zinc chloride in a liter of distilled water. The lightest layer (stock solution No. 2) was made to density 1.457 by dissolving 624 g. zinc chloride in a liter of water. The 2 stock solutions were mixed in various ratios and added to the gradient tubes according to the data in Table 1.

Table 1

Order of Addition	*Ratio, Heavy to Light Stock*	*Length of Layer*
Bottom	Undiluted stock No. 1	2 in.
2nd	5:1	1 in.
3rd	2:1	1 in.
4th	1:1	1 in.
5th	1:2	1 in.
6th	1:5	1 in.
Top	Undiluted stock No. 2	2 in.

Stock solutions were prepared by weighing the indicated quantities of dry zinc chloride as rapidly as possible in order to prevent taking up too much water from the air during the weighing. The solutions, stored in tightly stoppered bottles, were stable indefinitely. Solutions of intermediate density were made by mixing the stock solutions as required. It was found desirable to check the gradients with some known blood samples before setting up a series, inasmuch as the deliquescent properties of zinc chloride made it difficult to adjust the solutions to the proper density each time. If the stock solutions did not have the correct density, as measured with a pycnometer, they were adjusted before mixing them.

The tubes were filled by the method previously described.[7] Considerable care was necessary in order to duplicate the gradients exactly because the range of density in each was narrow so as to give high sensitivity. All tubes were allowed to equilibrate for at least 24 hours before use.

Blood Samples. Most samples were obtained by drying fresh blood at room temperature. Old dry samples were also used at times, and some samples were dried at various temperatures. As a rule, the sample was prepared by placing freshly drawn blood on glass plates to dry, and subsequently scraping it off with a razor blade, the dry powder being stored in stoppered vials. In some instances, blood was removed from other types of surface in a similar manner.

It was essential that contamination be avoided or carefully controlled. The effects of some types of contamination are discussed below. Another significant matter was the uniformity of the sample. When blood dries in a sufficiently large area, there is some clot retraction with higher concentration of corpuscles in the center, and a

tendency to leave serum at the edges of the area. Samples dried on glass showed this effect, even when the area was not very large. It was always essential to scrape off all of the sample so that it included both the heavier center region and the lighter serum portion.

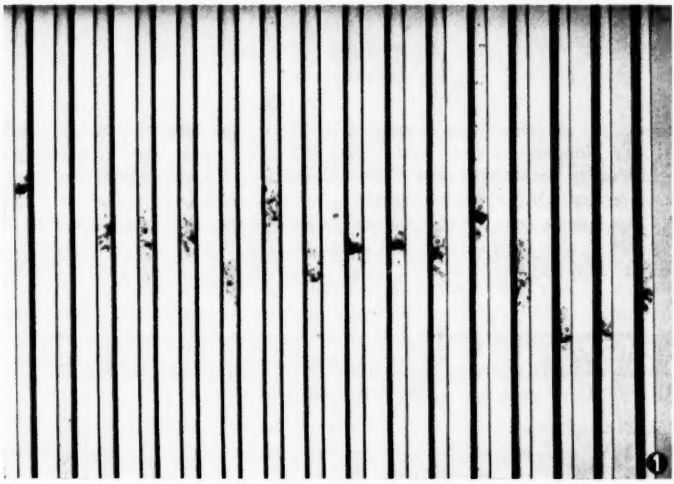

Fig. 1. Twelve different individuals.

The samples were finely powdered in an agate mortar to obtain a uniform and representative sample, and weighed. A sample size of 2 mg. was chosen so that the samples were equal and in sufficient amount to allow photographs of the tube to be taken readily. Considerably smaller samples could be employed, and 1 mg. samples were found to give excellent patterns that could be readily differentiated in the tubes.

Addition of the blood to the gradient was necessarily somewhat troublesome because of the difficulty of wetting the dry powder. The most successful method was to add the blood in small amounts, pushing each portion under the surface of the liquid with the end of a tooth-pick, and spinning the tube with the fingers to prevent clumping of the aggregates. The samples were allowed to settle in the equilibrated tubes for at least 12 hours, and preferably 24 hours, to develop their final distribution. The tubes had to be kept exactly vertical during the equilibration period to prevent the powdered blood from sticking to the glass. After the final settling, little if any change in the pattern was perceptible during several days of standing.

Results

The investigation was divided into 2 major parts, the first of which was concerned with proving the presence or absence of individual differences between bloods shed and stored under similar conditions. The second part was the study of the factors influencing the density distribution which might

serve to limit the application of the procedure. The total investigation actually involved the following specific studies:

1. Comparison of blood samples shed at the same time by numerous persons.
2. Comparison of blood samples shed by one person at different times.
3. Comparison of the density of inner and outer portions of single areas of dried blood.
4. The effect of drying temperature and conditions on blood density.
5. Comparison of 'fasting' and 'non-fasting' bloods.
6. Comparison of identical blood dried on different surfaces.
7. Comparison of blood scraped from different types of deposits.
8. Experimentation with procedures for eliminating contamination.
9. Comparison of blood samples taken simultaneously by different procedures.

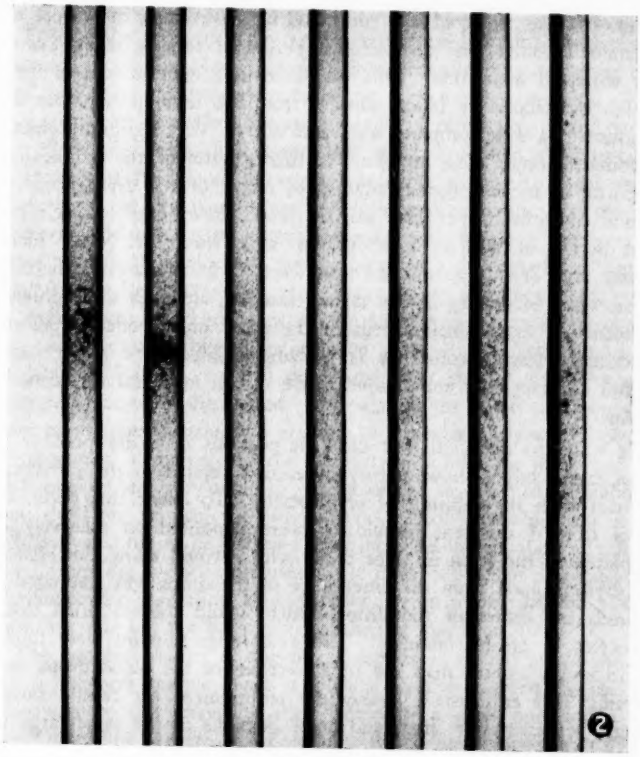

Fig. 2. Identical blood deposited differently.
1. Smear # 1
2. Smear # 2
3. Drops # 1
4. Drops # 2
5. Puddle # 1
6. Puddle # 2
7. Puddle # 3

The results can best be summarized under these headings, as follows:

1. Blood from a total of 30 individuals was compared by the same gradient tube technique. All samples in a single series were drawn at the same time and dried under the same conditions. The largest such series included blood from 19 persons. Every individual was found to be distinguishable from the other 29. One typical series of 12 individuals is shown in Fig. 1. In each series one or more samples were duplicated side by side as a control on the reproducibility of formation of the gradients. It is clear that only rarely will 2 blood samples from different persons give identical results, no such duplications having been found in the limited study reported here.

2. Since it was expected that the blood of a particular individual would not remain constant over an extended period of time, a study was made of the variation with time. This was done in 2 experiments, in the first of which old laboratory blood samples from the same person, but drawn at various times, were compared with each other. Very significant variations were found amongst these samples. In this experiment, the samples lacked any control as to the original amount of blood, or the drying conditions. A second controlled experiment utilized blood drawn from a single person over a period of 4 days at about the same time each day. Identical sampling and drying conditions were used. Here, likewise, there were differences in the density of the various samples, although these differences were relatively much smaller than in the other uncontrolled experiments. The tendency toward constancy is probably related to a rather constant diet, and the fact that the samples were drawn at about the same time each day.

3. It was also expected that different portions of a dry pool or large drop of blood might show density differences related to the retraction of blood clot with its trapping of erythrocytes. To check this point, blood samples from 3 different individuals were deposited on relatively clean glass plates, in the form of large drops which would allow clot retraction. After drying, blood from the outer edge of the drops was compared with that from the center of the drops, which would contain dried clot and erythrocytes in greater quantity. The outer edge samples were found to be considerably lighter than the inner sections of the blood drops, as was expected. This emphasized clearly the requirement for careful sampling to obtain representative inner and outer portions of the same large stain.

4. Effect of drying temperature was tested by using a finger tip sample of blood deposited on 5 different microscope slides, each of which was dried under different conditions. Drying took place at (*a*) room temperature, (*b*) a refrigerator, (*c*) near an open window, (*d*) a warm hot plate, and (*e*) under an infra-red lamp. Comparison of the 5 samples showed no detectable differences, demonstrating that any drying temperature low enough

to avoid charring of the blood will not alter the final density of the dry sample.

5. Inasmuch as the composition of blood is related to the diet, 2 samples were taken daily from a subject, one before breakfast and one following dinner, over a period of 5 days—a total of 10 samples. All drying and sampling conditions were otherwise identical. Comparison showed the after-dinner samples to be consistently, though not greatly, lighter than the early morning samples. The difference probably is attributable to the additional fat in the blood stream following dinner. This was also checked with 2 additional subjects under a somewhat more limited regime, but again non-fasting bloods were invariably found to be somewhat lighter than the respective fasting samples.

6. The density gradient tube would be expected to be sensitive to any contamination of the blood sample, thus providing a limitation to the general utility of any procedure based on contaminated samples. To test the magnitude of this effect the same sample of blood was placed on paint, a dirty floor, absorbent cloth, unfinished wood, sand and absorbent paper. After drying of the blood, an effort was made to grind up the material and segregate the dry blood from the solid contaminants. To the extent that blood could be separated from the solid with which it was mixed, the gradient tube itself would float the dry blood at a different level from such things as paint fragments, sand, etc. The problem of removing blood from such surfaces was found to be extremely difficult with available techniques. In no instance could blood be removed after it had been absorbed by cloth, nor could it be removed from any other similar absorbent surface such as paper or unfinished wood. On paint, if the blood could be scraped without paint contamination, no problem of reproducibility was encountered. The experiment demonstrated the necessity of obtaining the blood in an uncontaminated state, in order to reproduce the results. In favorable conditions this can be achieved where blood is on non-absorbent surfaces in sufficient quantity to be removed by mechanical means, short of removing material from the surface underneath. It is probable that a technique can be developed for separating adherent blood from some admixed materials, at least, but this has not been accomplished at this time.

7. The size and nature of the blood deposit is related to the ability to obtain a uniform sample from it. Thus, a large deposit of the blood will show more clot retraction than would be a small one, and a smear of blood would be expected to show none but to be removed with difficulty from the surface. To study the effect of size and type of blood deposit, the same sample of liquid blood was deposited in large areas (pools), in drops and in smears. After drying on glass these were removed and compared. No significant differences were present between drops and pools, although it must be noted that both were removed completely from the glass for complete sample. A definite difference was sometimes found

between the density distribution of smears scraped from glass and that for pools or drops. The material from a smear in which no clot retraction was possible was found to be much more homogenous than that from drops or pools, as shown in Fig. 2.

8. Since it is not known whether venous, arterial or capillary bloods might have different densities when dry, this question was approached by drawing capillary blood from the ear lobe and from the finger tip as separate samples, and a third sample from the vein of the left arm. It was not practical to obtain arterial blood. The samples were dried at room temperature in the form of small pools, and compared. No differences were noted between the density distribution of the 3 samples.

Discussion

The most important result of this investigation is the establishment that different dry blood samples will ordinarily have different densities and density distributions, unless they are from a single person, and shed at the same time. This being the case, distinction between different questioned deposits of blood may be made with great reliability if the blood is not contaminated with materials of different density.

The practical application of the procedure for distinguishing between blood samples must be limited, at present, to instances in which the deposits are on non-absorbent surfaces, from which they may be removed without disturbing the surface. Such situations are occasionally encountered in criminal acts that involve shedding of blood by more than one person. It is possible that extensions of the sampling procedure may be found, by which better separation of contaminants can be achieved.

The independence of the method from other known methods of discriminating between blood samples, such as grouping, gives it a unique advantage when the circumstances allow its application. Since ability to discriminate is much greater than is now possible by any other known method, the reliability of the technique in favorable cases must be considered to be superior to other procedures.

Summary

A technique is described for the comparison of density and density distribution of particles of dry blood by means of identical aqueous zinc chloride gradients.

It is demonstrated that different dry blood samples will rarely have the same density and density distribution unless they are from the same individual and drawn at the same time. Thus, discrimination may be made between 2 samples of blood shed at the same time by different individuals.

A total of 30 persons studied showed no indistinguishable duplication of gradient distribution of the finely powdered dry blood.

Sampling is critical to accurate results, inasmuch as different portions of a large blood deposit are not identical in the distributions of corpuscles and clot. Also, it is essential that solid materials other than blood be absent in the gradient tube if blood was actually on them, since the detachment of the blood from such material (cloth fibers, paint flakes, etc.) is not readily achieved.

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Purification of Plant Lectins by Continuous Electrophoresis

And Their Application to Grouping of Dry Blood Stains*

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Considerable interest has arisen in the use of plant extracts as serological reagents from the ability of some such extracts to agglutinate human red cells specifically, depending on the blood group.[1-3] Wiener *et al.*,[4] especially, have considered the application to grouping of dry blood stains, and the possible utility of the plant extracts, in the study of putative paternity, is evident.

While specific lectins (anti-A_1, anti-H, anti-A_2, anti-O, anti-M, and anti-N) have become available commercially in recent times, it is of interest, nevertheless, that the separation of mixed lectins appears always to be accomplished by adsorption procedures that waste the factors adsorbed. Thus, the extract of *Ulex Europaeus,* commercially available as anti-H lectin, agglutinates both O and A_2 cells. The material may be treated with O cells to prepare an anti-A_2 lectin, or with A_2B cells to prepare the anti-O fraction.

In addition to the limitations imposed in the preparation of individual lectins, little attention, except that by Wiener *et al.*,[4] has been given to specific applications for the grouping of blood spots or smears. Wiener used *Ulex E.* extract (anti-H) for indirect grouping of such material, as a means for confirming group O and A_1B stains for which conventional serological methods did not provide adequate controls.

In this publication is presented a preparative electrophoretic procedure for separation and recovery of active anti-O and anti-A_2 lectins from saline extract of the seeds of *Ulex Europaeus.* Also reported is a technique for indirect grouping in well-slides of dried blood stains in the ABO system, utilizing the active fractions of *Ulex E.* extracts, and of commercial anti-A_1 lectin prepared from *Dolichos biflorus.*†

* This investigation was supported in part by research grants from the National Institutes of Health, Public Health Service (RG-4848), and from the Research Committee of the University of California.

† All commercial lectins were obtained from Hyland Laboratories, Los Angeles.

Experimental

To extract the lectin from *Ulex Europaeus* seeds, a sample of about 5 g. was ground in a mortar with a few drops of isotonic saline solution sufficient to keep the mass moist. After the seeds were reduced to a fine pulp, 5 ml. of saline were added and the mixture placed in a refrigerator for 8 hours. The pulp was then reground and refrigerated for another 16 hours.

The pulp was then centrifuged, the supernatant removed, and the pulp washed with an additional 1 ml. of saline which was combined with the first extract. The extract was filtered through a Seitz filter into a sterile vessel, and in some instances sodium azide was added as a preservative, to a concentration of 0.1%. The sterile solution was frozen and dried from the frozen state. The dry powder could be kept for months without deterioration. For use, it was reconstituted with distilled water.

The reconstituted solution could be treated in the conventional manner with either group O or group A_2B cells to adsorb the corresponding fraction from the extract. This procedure was used satisfactorily to prepare both active fractions of the extract. More satisfactorily, the mixed lectins were separated by continuous preparative electrophoresis.

Procedure of Separation. The apparatus† and technique were those previously described.[5] The buffer reservoirs and end vessels were filled with buffer of 0.01 M sodium bicarbonate made 0.01 M in ammonium chloride, giving a pH of approximately 8.5. The entire apparatus was kept in a refrigerator during the operation, which was continued for 6 hours at 450 v., the fractions being collected in receiver tubes.

Five fractions were obtained, two of which were ninhydrin reactive and could be located on the paper ahead of the drip points, by spraying with an 0.1% ninhydrin solution and heating. One fraction was green in color and undoubtedly was chlorophyll. One fraction contained anti-O activity and the fifth, anti-A_2.

Electrophoresis was also carried out in a series of phosphate and borate buffers ranging in pH from about 2 to about 10, in order to choose the system giving the best separation. Fractions collected in the receiver tubes were always considerably diluted with buffer and required removal of water and/or salt. The general procedure was to freeze the collected liquid and dry it from the frozen state. This left the salts present with the active material. The dry product was reconstituted with enough water to give an approximately isotonic solution. Lyophilized lectin samples showed no deterioration on storage during the time of several months experimentation.

An alternative procedure which removed the salt as well as water was to dialyze the collected fraction in a cellophane bag against a large volume of distilled water. After dialysis the bag was removed and suspended in front of a stream of rapidly moving air, which removed most of the water over a period of about 26 hours. Material prepared in this way was reconstituted with physiological saline solution to maintain isotonicity.

Direct Blood Grouping. Plant extract agglutinins, in contrast to animal sera, show a considerable degree of nonspecific agglutination, greater with *Ulex* extracts than with those of *Dolichos*. This specific effect is much faster in all instances than the nonspecific, so that proper control of time and dilution separates clearly between them.

Because of the necessity of close control of conditions, careful preliminary dilution tests were necessary, utilizing cells of known blood groups. While it is necessary to check all the blood groups to assure specificity of an extract, the nonspecific agglutination may be corrected by standardizing against the corresponding cells, and

† Obtainable from Microchemical Specialties Co., Berkeley, California.

cells of another group that shows only nonspecific agglutination. Thus, in standardizing anti-A_2 lectin, cells from A_2 blood and those from A_1 blood were used, the first to determine the proper time and dilution for specific agglutination, the latter to determine how soon, and at what dilution, the nonspecific effect began. A time and concentration were so chosen as to give strong agglutination with A_2 cells, and none with A_1 cells. The times were generally between 10 and 20 minutes. The dilutions were moderate with reconstituted lectin solution, and in some preparations it was found necessary to utilize full strength material. Exact time and dilution was variable from batch to batch, and required determination for each batch.

Both in the preliminary standardization of conditions, and in the actual grouping, 20 μl. of lectin solution was used uniformly. This was added to a well in the spot plate, and to it was added 1 μl. of a 2% solution of the questioned blood. In general, the dilution was performed by drawing 40 μl. of blood from a fingertip puncture and adding it with shaking to 2 ml. of physiological saline solution.

After charging the wells of the spot plate with the various samples studied, the plate was placed on an Eberbach Rotator and stirred at a constant anad predetermined rate for the time specified by the dilution study. The stirring, which also required standardization, was readily kept constant in this manner throughout all of the experimentation.

Once standardized, the procedure could readily be adjusted to the conditions existing with each batch of extract, inasmuch as these tended to be closely comparable when prepared in the same manner. It was also found that samples of lectin prepared in the laboratory were very similar in the necessary working requirements to those purchased from commercial sources.

Agglutination of the cells was uniformly observed microscopically in the various spot plate depressions. In each instance a degree was assigned as + for just detectable agglutination to ++++ for complete agglutination in the time chosen. When classified as + it was taken as a possible indication that the lectin was too dilute, while ++++ raised the question of possible nonspecific agglutination. Groups were not considered as proved unless the agglutination was ++ or +++.

Procedure of Indirect Blood Grouping. In order to be useful for the grouping of dry blood which is old enough to have lost its active agglutinins, the lectin must serve in lieu of anti-serum for adsorption grouping. Such a procedure was developed and yielded reproducible and reliable results when properly performed. As with direct grouping, distinction was necessary between specific and nonspecific agglutination, the latter being a significant factor especially with *Ulex* extracts, though present to a degree with all plant lectins tested. As with direct grouping, time, stirring and dilution required standardization and testing of a dilution series against known cells. At the same time the difficulties of performing these standardizations were not greater than with direct grouping. Dry lyophilized lectin reconstituted with water or, alternatively, dialyzed, pervaporated and reconstituted with physiological saline, was diluted serially. To 20 μl. of each dilution on a spot plate were added 1 μl. of washed red blood cells suspension of the proper type prepared by diluting 2 volumes of the original blood with 100 volumes of physiological saline as previously described. Washing of the cells was generally performed four or five times with physiological saline interspersed with centrifugation. A series of diluted lectins to which cells had been added was stirred on the rotator a predetermined chosen time, usually 14 to 16 minutes, and examined microscopically. Agglutination was graded from + to ++++ as described above. The lowest titer giving moderately strong (++ to +++) agglutination was chosen for use with the unknowns.

A fragment of the questioned blood was soaked for 6 hours, in a refrigerator, in about 100 μl. of lectin solution of the proper titer as determined above. A 20 μl.

sample was then removed, placed on the spot plate, and to it was added 1 μl. of the same cell suspension used in standardization. The mixture was again stirred for the chosen time and examined as before. Under the standardized procedure total, or nearly total, inhibition was found uniformly with bloods of corresponding type. Stirring for much longer than the chosen time generally led to agglutination regardless of the group of the blood. The time difference was sufficient that sharp distinction was possible in virtually all instances.

Results

The use of lectins for direct grouping of blood has been performed in numerous laboratories and is an accepted procedure. Likewise, the use of anti-H for secretor testing is a standardized and accepted procedure. The application to determination of blood groups in dry specimens, which requires adsorption grouping, has been reported as a control for O and A_1B bloods only. For purposes of this study, bloods of known group, as determined by conventional methods with anti-A and anti-B sera, were tested in dry form with the lectins prepared as described. A total of more than 50 individual bloods were grouped indirectly as indicated, fourteen of these being grouped independently by two different persons in the laboratory for confirmation of the reliability of the method in different hands. With two bloods there was an initial disagreement on sub-group. In no instance was disagreement found on the main group, and in no instance were different results found with the lectins than with any serum of the conventional type.

In addition to testing of bloods with the lectins prepared electrophoretically and by adsorption in this laboratory, commercial samples* were used in the same manner. No significant and regular differences between behaviour and/or concentration of commercial lectins and the prepared lectins were found. This was true of anti-O and anti-A_2, all A_1 lectins being of commercial origin. Any grouping performed for B factor had to be done with conventional anti-B serum. It is believed, as a result of these experiments, that in terms of reliability and simplicity the plant lectin grouping is not inferior to grouping with anti-A and anti-B sera as conventionally used. Somewhat more attention must be given to standardization of conditions, while controls with known cells are required throughout. It will be noted, however, that these are likewise requirements for properly performed grouping with animal sera, and the difficulties are of the same order of magnitude. The major factor of difference is in the original concentration of lectin as extracted from the plant, that difference carrying through all subsequent separation operations, storage and reconstitution of the material. A major factor of advantage with the lectins is the ability to store them, apparently indefinitely, when properly prepared, which cannot be done equally well with the animal anti-serum.

* All commercial samples were obtained from Hyland Laboratories, Los Angeles.

Summary

An electrophoretic procedure for separating the anti-O and the anti-A_1 lectins from extract of the seeds of *Ulex Europaeus,* and from each other, is described.

The utilization of these lectins, as well as of commercial anti-A_1 lectin, for direct grouping of blood and indirect grouping of blood stains was studied. Completely satisfactory results were obtained with both techniques.

It is concluded that plant lectins have an important function in criminalistic blood testing.

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A Precise Method for the Determination of Iron and Haemoglobin in Blood

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Most methods for the determination of iron in blood consist of 2 main stages. Firstly, it is necessary to ' free ' the iron from its porphyrin complex; secondly, the ' freed ' iron must be quantitatively estimated.

One of the earliest and, perhaps, most widely used methods is that of Wong[1] who used sulphuric acid to release the iron from haemoglobin and then precipitated proteins by tungstic acid. In methods of this type, there is some uncertainty as to whether all the iron has been released and, furthermore, it is sometimes impossible to obtain a *clear* protein-free filtrate, especially when dealing with post-mortem blood.

Middleton and Stuckey[2] have given an excellent review of the preparation of biological material for the determination of trace metals and have recommended a method[3] for the destruction of organic matter in biological material. As regards dry-ashing procedures, Monier-Williams[4] found that there is a risk of loss of iron by volatilization, particularly if chlorides are not removed before ashing; Tompsett[5] obtained poor recoveries of iron when silica vessels were used for ashing and he recommended addition of sodium phosphate to prevent losses. Jackson[6] came to the conclusion that wet-ashing was probably more satisfactory than dry-ashing.

The use of perchloric acid for destruction of organic matter for micro-determination of trace elements has been extensively studied by Smith and his co-workers.[7-9] They have shown that when perchloric acid is properly used the results are obtained much more quickly than with conventional methods and are equally safe and reliable.

For the assay of the iron in the protein-free solution, Wong[1] used the red colour of the complex produced by addition of thiocyanate. Coombs,[10] Jenkins and Thomson,[11] and Breuer and Militzer[12] found difficulty in obtaining reproducible results with Wong's[1] method. Fading of the colour of the ferric thiocyanate complex and development of turbidity in the coloured solution were two of the factors contributing to the uncertainty. Some of these difficulties had been overcome earlier by Kennedy,[13] who, afer wet-ashing, extracted the thiocyanate colour into amyl alcohol. Delory,[14] Thorp,[15] and Watson,[16] have used 2:2′-dipyridyl for colour development. In King's[17] method, the iron in the residue after dry-ashing is determined by titration with titanous chloride. More recently Häberli[18] has proposed a method for the direct titration of iron (following wet-ashing) with diaminoethane tetra-acetate (EDTA) using ' Tiron ' (disodium-1,2,-dihydroxybenzene-3,5-disulphonate) as indicator. Solutions of titanous chloride are unstable; Häberli's[18] method does not give a very satisfactory end point. Very recently, a micromethod for estimation of iron in haemoglobin has been proposed by Fischl.[19] In this method, iron is freed by sulphuric acid and persulphate, as in Wong's[1] method, but proteins are not precipitated. The colour developed on addition of thiocyanate is extracted into a mixture of acetone and isobutyl alcohol for colorimetry. Again, there may be doubt as to whether all the iron has been released and whether any substances are present which might inhibit full colour

development. Furthermore, if the mixture is not shaken *immediately* after addition of colour reagent, the colour fades; also great care must be taken to prevent any water from getting into the coloured supernatant liquid otherwise an emulsion forms.

From this discussion it would appear that there is a need for a reliable method for determination of iron (and, hence, haemoglobin) in blood which is also applicable to post-mortem blood and which does not involve too lengthy a procedure. In this connexion, the use of perchloric acid to destroy organic matter has been found to be excellent and is strongly recommended in the method which is described below.

For estimation of the iron, a reaction is employed which was first described by Cheng and Lott[20] and which has since been developed or modified by Ringbom, Siitonen and Saxén[21], Schneider and Janko[22] and Lott and Cheng.[23] The reaction consists of addition of EDTA to the iron solution followed by hydrogen peroxide. When this mixture is made alkaline, a stable purple colour is produced. This reaction has been found most suitable for the determination of iron in amounts of blood of the order of 0.5 ml.

Reagents:

De-ionized water was used throughout.

Perchloric acid—60%.

EDTA solution—0.1M solution of the disodium salt of diaminoethane tetra-acetic acid.

Hydrogen peroxide—30% solution.

Ammonia solution—Sp. Gr. 0.88.

Standard iron solution—0.25 mg. Fe per ml.

Dissolve 25 mg. of pure iron wire in about 3 ml. of hot perchloric acid. When cool, dilute the solution to 100 ml. with water.

Procedure. Rinse 0.5 ml. of blood into 2 ml. of water contained in an 8 inches × 1 inch boiling tube. Add 4 ml. of 60% perchloric acid and a small glass bead. Boil over a small flame until the mixture is almost colourless. This takes about 20 minutes. Cool and add 10 ml. of water and 2 ml. of 0.1M-EDTA. Mix gently to dissolve any crystals which may have formed whilst cooling. Transfer the solution quantitatively to a 50 ml. volumetric flask using water as the wash liquid. After the transfer, the volume of liquid in the flask should be about 25 ml.

Next add 0.5 ml. of 30% hydrogen peroxide and then dilute to 50 ml. with ammonia solution (Sp. Gr. 0.88). Mix thoroughly and read in a 'Spekker' absorptiometer using Ilford filter No. 4 (maximum transmission at ca.520 mμ) and 4 cm. cells.

Standard. To 1.0 ml. of standard iron solution contained in a 50 ml. volumetric flask, add 2 ml. of 60% perchloric acid. Dilute with water to about 25 ml. and add 2 ml. of 0.1M-EDTA. Add 0.5 ml. of 30% hydrogen peroxide and then dilute to 50 ml. with ammonia solution. Mix thoroughly and read in a 'Spekker' as above.

Blank. This is prepared in the same way as 'Standard' but the 1.0 ml. of standard iron solution is omitted.

Calculation:

$$\text{mg. of Fe per 100 ml. of blood} = \frac{A_t \times 50}{A_s}$$

where A_t = Absorbance of 'Test' solution
and A_s = Absorbance of 'Standard' solution

To obtain g. of haemoglobin per 100 ml. of blood, divide this result by 3.38.

Precision of the Method

A sample of pooled post-mortem blood was used to test the precision of the method. Ten determinations of iron were made using the method.

The values found were: 15.1, 15.2, 15.1, 14.7, 15.0, 15.0, 14.7, 15.0, 15.0, 15.3, g. per 100 ml. The arithmetic mean of the results is 15.0 and the standard deviation is 0.19.

Summary

A rapid and precise method for determination of iron (and haemoglobin) in blood is described which overcomes the shortcomings of previous methods.

Wet-ashing of blood with perchloric acid is followed by reaction of the iron with EDTA and hydrogen peroxide.

The colour developed on making the solution alkaline is determined spectrophotometrically.

A standard deviation of 0.19 was obtained from ten analyses of a blood sample.

The method is particularly suitable as a rapid and precise standard method for haemoglobin determination.

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Reviews of Books

A Policeman's Lot

Beverley Hills is My Beat. Clinton H. Anderson. (1960. Pp. 224. With Illustrations. 21s. net). London: W. H. Allen.

This is a readable account of a policeman's intimate and extensive association with crime as it occurs in Beverly Hills.

The author is an articulate officer capable of writing grammatical English. He is an excellent raconteur and fills in interesting background data on such incidents as the killing of Johnny Stompanato by 14-year old Cheryl Crane (Lana Turner's daughter); the mysterious gangster killing of Bugsy Siegel and the extraordinary finding by a court that Charlie Chaplin legally fathered a child—an act which, according to scientific blood tests, was biologically impossible.

Apparently the problems of specialization in the practice of law and medicine have also reared their awkward heads in police work. In Chief Anderson's view this trend leads to a more mechanical attitude towards police work than the old time officers had. In smaller cities the need for the general practitioner in policing, however, still remains.

The book concludes with some observation on the causes and treatment of delinquency and the statistics of crime. It is not encouraging to note that over a 10-year period major crime increased annually 3 times as fast as the increase in population during the same period. To dedicated policemen, however, this kind of statistic is a professional challenge, reinforcing a determination to protect society and uphold the law.

Murder by Alphabet

A Companion to Murder. By E. Spencer Shew. (1960. Pp. 295 + Index. 25s. net).
London: Cassell & Company Limited.

Mr. E. Spencer Shew has undertaken an unusual task in compiling a dictionary of crime, criminals and the judges and barristers involved in the relevant trials.

The material is arranged in alphabetical order, with very thorough cross-references.

A lot of care has clearly gone into the preparation of the biographical *vignettes*; and the synopses of the various cases are very accurate epitomes.

Almost every conceivable case of any consequence, interest or notoriety which has occurred in the first half of this century, has been included in what is virtually a criminological encyclopaedia.

This very adequate volume has not only intrinsic interest, due to the nature of the material traversed by the author, but it should also prove an invaluable, if not indispensable companion to the forensic teacher and lecturer.

Crime Round-Up

Famous Criminal Cases: VI. Donald Hume; Mrs. Edith Chubb; Ernest Fantle; Sergeant Roy Hicks; Henry Marwood; George Carter; Sergeant Marymont; Michael Dowdall; Cavan Malone; Patrick Byrne; Guenther Podola; The Big Robberies and Unsolved Mysteries. By R. Furneaux. (1960. Pp. 256. With Illustrations. 21s.).
London: Odhams Press Limited.

Mr. Rupert Furneaux has undoubtedly become one of the outstanding exponents of forensic journalism. His latest volume is the sixth in a series devoted to criminal cases of unusual interest. The book is light reading and should therefore appeal to medical and legal practitioners for their leisure hours.

In a 48-page *Foreword* Mr. Furneaux surveys the criminal scene. He then devotes the remaining 200 pages or so to a more detailed presentation of particular cases.

Mr. Furneaux discusses the interesting situation (p. 38) which arose when the police record of a tapped telephone call was subpoenaed and given in evidence before the Disciplinary Committee of the General Medical Council which was considering a charge of 'infamous conduct' alleged against a medical practitioner. In the United Kingdom a body with powers to subpoena could force the police to make such a record available. From this the Home Secretary could claim Crown Privilege. It would be interesting to speculate on a similar situation in this country.

Arsenical poisoning is today a rare form of criminal activity in the United Kingdom, unlike the position in South Africa, where several cases have in recent years aroused much public interest. Poisoning is *par excellence* a female criminal weapon. The case in which Sergeant Marymont murdered his wife

with arsenic therefore has additional interest.

It is, however, a little difficult to follow the reasoning whereby Dr. Francis Camps expressed the view that the action of arsenic would be quickened 'if taken in a chocolate drink' (p. 140). Dr. Camps was also presented as an expert who had done 60,000 autopsies. Assuming that these have been spread over a professional life-time of 25 years, this would average out a performance of some 7 autopsies daily, including Saturdays, Sundays, public holidays and leap years. This may be a record of some kind, but more likely qualifies for the doubtful distinction of a quantitative achievement testifying to the physical stamina of the witness.

The problem of the true sexual psychopath is very well presented in the case of Patrick Byrne, who murdered Miss Baird at a YWCA hostel in Birmingham. The judge had directed the jury that they could not regard abnormal sexual impulses as coming within the provisions of the Homicide Act, 1957. Byrne was found guilty of murder and appealed on the ground that the judge's direction to the jury was wrong. In July 1960 the Court of Criminal Appeal allowed the appeal.

'In their view there was no ground in law for saying that an abnormality of mind consisting in an inability or difficulty in controlling sexual impulses was not such an abnormality as came within the Act, and it was for the jury to decide whether in fact the accused was suffering from such an abnormality and whether in fact such abnormality substantially impaired his mental responsibility for his acts. Since by reason of the judge's direction to them the jury had been precluded from considering these matters the verdict of murder could not stand and the Court of Criminal Appeal accordingly substituted a verdict of manslaughter. While the appeal therefore conferred the benefit of clarifying the law it made no practical difference to Byrne, whose sentence of life imprisonment the court confirmed for the lesser offence. For a man of his tendencies no lesser sentence was really possible' (pp. 189-190).

In dealing with the case of George Carter, a 29-year-old labourer found guilty of murdering his pregnant wife, there is an interesting reference to the fact that the 6-year old child (who had also been assaulted on the head) could not remember anything that had happened in the 2 or 3 months before the murder, except for isolated patches. So long a period of retrograde amnesia is unusual. Such an eminent authority as Ritchie Russell has never seen permanent retrograde amnesia lasting more than a week before the injury. (Vide *The Lancet*, 5 October 1935, p. 762).

There is clearly much of forensic interest, both for legal and medical practitioners, in this very readable volume.

Forensic Medicine

Aids to Forensic Medicine and Toxicology. By Sir W. Bentley Purchase, *C.B.E., M.C.*, M.B., M.A., M.R.C.S., L.R.C.P. (1960. Pp. 254 + Index. 12s. 6d. Postage 1s.). London: Baillière, Tindall and Cox Limited.

Students have long recognized the value of the *Aids* series, when preparing for their final professional examinations. Dr. Bentley Purchase's volume has seen 12 previous editions and should prove of value to dental as well as medical students.

Although the purely legal sections of the book (part 1) have their main application in the United Kingdom, this should not detract from the value of the manual in other parts of the Commonwealth. There is no doubt that an amazing amount of information has been condensed within a very small compass.

The author has appreciated the important point that asphyxia is a clinical rather than a pathological entity, a concept which students as well as practitioners should find helpful in understanding the non-specific necropsy observations.

It is surprising, therefore, that the author attributes importance to such non-specific signs as Tardieu spots and perpetuates the mythological view that in asphyxial deaths the 'right heart is full and the blood dark and venous.'

Fully a third of the book is devoted to *Toxicology*. A feature of this section, as of the other sections, is to introduce the student to clinical features wherever they may be relevant.

The author provides a useful account of the clinical examination of persons suspected of being inebriated and stresses the importance of excluding disease which may otherwise account for the the symptoms and signs observed (p. 234). There is also a clear exposition of the fact that alcoholic intoxication does not occur at a fixed arbitrary level of alcohol in the blood.

The manual concludes with an index, which could be more comprehensive, e.g. *rigor mortis* is not listed.